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U. S. DEPARTMENT OF COMMERCE

BUREAU OF FISHERIES

REPORT

OF THE

UNITED STATES COMMISSIONER OF FISHERIES

FOR THE FISCAL YEAR 1930

WITH

APPENDIXES

HENRY O'MALLEY
Commissioner

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1931

ERRATA

Page 6, third line: The word *no* should be inserted following the word *be*.
Page 88, Table 3: In the first box head *Tid* should be *Tide*.
Page 123, third line: *Agricultural* should be *Aquicultural*.
Page 177, third line: *Agricultural* should be *Aquicultural*.
Page 320, fifth line: *$3,467.50* should be *$3;476.50*.
Page 588, table on American opening prices: Under 1927, Medium red or coho should read in the last column *1.50–1.65;* and Pink should be *1.10–1.15*.
Page 735: Last figure in last column should be *19*.
Page 737: No dollar signs should appear in the table.

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U. S. DEPARTMENT OF COMMERCE

BUREAU OF FISHERIES

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REPORT OF THE COMMISSIONER OF FISHERIES[1]

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[1] Bureau of Fisheries Document No. 1071.

Department of Commerce,
Bureau of Fisheries,
Washington, July 1, 1930.

The honorable the Secretary of Commerce.

Dear Mr. Secretary: I have the honor to submit the following report of the operations of the Bureau of Fisheries during the fiscal year ended June 30, 1930.

There is much evidence of an intensified interest in the future welfare of our fisheries. Sportsmen's organizations are concentrating their efforts to provide better angling, to overcome the evils of pollution, and to obtain the passage of State and Federal laws which will more adequately conserve this great natural resource. Commercial fishermen are taking a greater harvest from the waters than ever before, are introducing greatly improved methods, and are revealing a greater interest in the proper conservation of this resource as a sound economic policy. State governments are giving more and more attention to legislation affecting the fisheries, and State executives are revealing greater interest in the selection of capable administrators in their departments of conservation. The State Department has negotiated with Canada a revised convention for the preservation of the halibut fishery of the North Pacific Ocean and a convention for the preservation and extension of the sockeye salmon fisheries breeding in the Fraser River system, which now await ratification by the Senate. Greater cooperation is requested from the bureau by other Federal agencies in the heavier stocking of the waterways on public lands with game fish and in working out a stream-stocking policy to insure good fishing to the millions of our people who visit our national parks and forests annually. Congress has also revealed a greater interest in fishery problems in the passage of a 5-year construction and maintenance program for the Bureau of Fisheries, an amended black-bass law of much broader power, provision for the study of the probable effect on the fisheries of the proposed power project in Passamaquoddy Bay, and by the Senate's action in creating a special committee on the wild life resources of the country.

The Bureau of Fisheries finds a reflection of this intensified interest in the increased demands for fish for stocking waters, for additional fish-cultural facilities, and aid to a greater number of private organizations interested in the cooperative rearing of fish for stocking local streams. This is also true of the demands for scientific investigations to disclose the need of stronger conservation measures; for studies of every important fishery to reveal its condition and trend; for an expansion of its investigative program with respect to such aquicultural pursuits as oyster farming, fish farming, and the control and prevention of diseases. Likewise more intelligent interest is being shown in the solution of the problems of the commercial fisheries, improvements in methods of manufacturing and merchandising, in the use of by-products, and in the conduct of fundamental investigations with respect to processes, nutrition, and uses.

The success of the bureau's efforts in rehabilitating the fur-seal herd breeding on the Pribilof Islands, from 130,000 animals to 1,000,000 in less than 20 years, and in saving the important Alaskan salmon runs from exhaustion has received much favorable comment. For the first time in 40 years the killings of fur seals on the Pribilofs in 1929 exceeded 40,000 animals.

The output of the bureau's fish-cultural service in the stocking of streams exceeded 7,570,000,000 fish and eggs as compared with 7,060,000,000 in 1929.

The commercial fisheries of the United States and Alaska are in a sound economic condition. They furnish employment to more than 125,000 commercial fishermen and 4,000 persons engaged in the transportation of the catch. The annual harvest is in excess of 3,000,000,000 pounds, for which the fishermen receive $116,000,000. Edible fishery products constitute over 2,600,000,000 pounds for sale in the fresh state or for manufacture. In the fresh-fish trade of 1929, 84,397,000 pounds were prepared in packaged form valued at $14,813,000, and 121,543,000 pounds of fishery products were frozen. In the canning trade—the most important process of manufacture—the pack amounted to 689,447,000 pounds, valued at $101,065,000. The output of cured and smoked fishery products is estimated at 150,000,000 pounds valued at $12,000,000, and the output of fishery by-products was valued at $23,768,000. This included fish oil, meal, lime and grit from oyster shells, buttons from fresh-water mussel shells, and many other products. Imports of fishery products were valued at $66,566,000 and exports at $23,830,000. In 1929 as compared with 1928 there were substantial increases in the output of packaged and frozen fish, canned fishery products, by-products, imports, and exports.

INTERNATIONAL RELATIONS

NORTH PACIFIC HALIBUT CONVENTION

The International Fisheries Commission provided for under this convention has issued two reports on its work. The first entitled "Report of the International Fisheries Commission Appointed under the Northern Pacific Halibut Treaty" (Bureau of Fisheries Document No. 1073) contains various recommendations which are believed necessary for the saving of this great fishery. The second report entitled "Life History of the Pacific Halibut: (1) Marking Experiments" was published in Canada and is available only through the commission.

The results of the commission's investigations reveal that the abundance of fish on the older halibut banks is now only one-sixth of that 20 years ago. Indications are that the decline in abundance on the newer banks continues at a rapid rate, and on the older banks the stock is at the minimum level upon which the fleet can exist. In fact in places the vessels are now dependent upon other less desirable species. Marking experiments indicate that on the British Columbia banks 40 per cent of the stock of commercial sizes is removed yearly. The residual immature population migrates but little and only by a random scattering movement, averaging less than 20 miles for the period between tagging and recapture. A much smaller percentage of the large mature fish of the Alaskan banks is caught annually. These migrate along the coast of the Alaskan Peninsula, averaging about 200 miles between tagging and recovery. These studies demonstrate the independence of the stocks of market fish on the Alaskan banks from the Canadian banks and support the previous recommendations of the commission.

To ascertain the spawning grounds, the abundance and direction of drift of eggs and larvæ, and the source of supply of fish populating the various banks and their interdependence, it has become necessary to make a series of tow-net hauls. During the early part of 1929 a large series of such hauls were made in the Gulf of Alaska and between Cape Flattery and Dixon Entrance, especially on the Goose Island grounds. In 1930 other series of hauls were made in Hecate Strait and Dixon Entrance and off the coast of Queen Charlotte Islands. A study of the first series in the Gulf of Alaska indicates the presence of larvæ well out in the gulf, although they were much less abundant than they were along the edge of the continental slope of the Alaskan coast. Hauls made in May along the Canadian waters were much too early to reveal the possible influx of larval fish from Alaskan waters and later more extensive collections became a necessity.

Because of the inadequacy of the existing convention as revealed by the commission's investigations and the urgent need for putting the commission's recommendations into effect, negotiations for a new convention were initiated, and on May 9, 1930, a revised convention was signed at Ottawa. When ratified by the United States Senate this will supplant the convention concluded March 2, 1923.

SOCKEYE SALMON CONVENTION

For many years efforts have been made to work out arrangements for the rehabilitation of the sockeye salmon run of the Fraser River system, British Columbia, through the medium of an international convention with Canada. The convention signed on March 27, 1929, referred to in the last annual report, was subsequently withdrawn and another convention, which has for its purposes the protection, preservation, and the extension of this fishery, was signed on May 26, 1930. The convention covers the sockeye-salmon fishery in the waters contiguous to the State of Washington and the Province of British Columbia, the territorial waters off the coasts of Washington and British Columbia, and the high seas adjacent thereto—the waters covered being defined in the convention. The International Fisheries Commission of six members, provided for in the convention, is charged with the duty of making a thorough investigation into the natural history of the sockeye salmon. It is authorized to construct and maintain hatcheries, and is empowered to prescribe the size of mesh of the gear used. The convention is concluded for a period of 16 years, after which it is subject to termination on notice of 1 year given by either Government.

In 1913 the pack of sockeye salmon in Puget Sound was 1,673,099 cases and in the Fraser River area the pack of Canada was 684,596 cases, making a total of 2,357,695 cases. In 1929 the pack was only 111,898 and 60,393 cases, respectively, making a total of 172,291 cases. The prompt ratification of this convention is important to permit of international cooperation in the rehabilitation of this very important fishery.

PASSAMAQUODDY POWER PROJECT

The proposed damming of Passamaquoddy and Cobscook Bays to develop hydroelectric power may adversely affect the fisheries of the Bay of Fundy and the coast of Maine. A subcommittee of the North American Committee on Fishery Investigations reported on December 12, 1928, as follows:

1. That in its opinion if the proposed construction is carried out, the weir fisheries for herring inside the dams will be almost wholly eliminated.

2. That it is recognized that the effects on the fisheries outside the dams, predicted in the report on the subject presented by Doctor Huntsman, may follow, but the committee as a whole is not prepared to forecast whether these results will or will not follow, believing that a fuller investigation is necessary.

It is agreed that the peculiar hydrographic conditions in the vicinity of Passamaquoddy Bay result in the upwelling of deep water from the Gulf of Maine, bringing with it abundant stores of dissolved chemicals necessary for the production of a wealth of plant and animal life which are the basic food supply of fish. The abundance of these microscopic forms is believed to be responsible for the remarkable concentration of the herring and pollock fisheries in Charlotte County, New Brunswick, and the adjacent coast of Maine. There are grounds for belief that the installation of the proposed dams may so change natural oceanographic circulation as to materially reduce the production of fish food and influence the spawning of the herring and thus may have an important effect on these fisheries.

In 1928 the catch of fish in the general region which may be affected amounted to 190,000,000 pounds valued at nearly $5,000,000. Of the total, 130,000,000 pounds were herring and 10,000,000 pounds pollock.

On September 20, 1929, the Canadian Government proposed an investigation by the joint efforts of the two Governments, requiring at least two years of field observations at an estimated cost of $45,000 per annum.

An appropriation of $22,500 for meeting the United States share of expenses for the fiscal year beginning July 1, 1930, was made by Congress.

INTERNATIONAL FUR TRADE EXHIBITION AND CONGRESS AT LEIPZIG

A joint resolution of Congress approved March 21, 1930, authorized participation by the Government of the United States in the International Fur Trade Exhibition and Congress held in Leipzig, Germany, in 1930. An appropriation of $30,000 was granted for the preparation, transportation, and demonstration of an exhibit portraying the development of the fur industry in the United States and the production, conservation, and utilization of fur as a natural resource.

The joint display of the Department of Agriculture and the Department of Commerce was a modern presentation of fur resources and conservation measures and compared favorably with showings by other nations. The display of the Department of Commerce had to do chiefly with the fur-seal activities of the Pribilof Islands, as administered through the Bureau of Fisheries, and included mounted fur seals and blue foxes, fur-seal skins, an allegorical presentation showing how international cooperation saved the Alaskan fur-seal herd from extinction, lantern slides automatically shown, colored transparencies, and motion pictures. Appropriate descriptive literature, printed both in English and German, was prepared for distribution to interested persons.

It is felt that the exhibit and congress have been of genuine benefit in stimulating interest in the fur resources of the United States.

DOMESTIC RELATIONS

FIVE-YEAR CONSTRUCTION AND MAINTENANCE PROGRAM

For several years there has been strong support of a measure sponsored by Congressman White, of Maine, chairman of the Merchant Marine and Fisheries Committee, to provide a 5-year construction and maintenance program for the bureau. Such an act was approved May 21, 1930 (Public, No. 240, 71st Cong., H. R. 7405). This act authorizes additional appropriations for new fish-cultural stations and substations, three new laboratories, and two new distribution cars, to the amount of $1,885,000. It also authorizes annual increases in the appropriation for the division of fish culture of $100,000 for the 5-year period and increases in present appropriations for the divisions of scientific inquiry and fishery industries by not to exceed $300,000 and $175,000 per annum, respectively. Under the provisions of the act the bureau may cooperate with States, counties, municipalities, individuals, and public and private agencies, organizations, and institutions, and may accept donations of lands, funds, and other aid to the development of this program. The provisions for an orderly development of its fish-cultural and other agencies will have a far-reaching effect in placing the bureau in position to meet the demands made upon it, and the provisions for increased personnel will be extremely helpful in building up a staff of experts capable of coping with the situation.

The act follows:

[Public—No. 240—71st Congress]

[H. R. 7405]

An Act To provide for a five-year construction and maintenance program for the United States Bureau of Fisheries

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there are hereby authorized to be appropriated during the fiscal year beginning July 1, 1930, such amounts as may be necessary for—

(1) The establishment of a fish-cultural station in each of the following States, at a cost not to exceed the amount specified: New Mexico, $50,000; Louisiana, $50,000; Idaho, $60,000.

(2) The establishment of a fish-cultural substation in each of the following States, at a cost not to exceed the amount specified: Wisconsin (in the southern part of the State), $50,000; Montana, $35,000; Colorado, $35,000; New Hampshire (in the White Mountain Forest), $25,000.

(3) The establishment of a fishery laboratory in the State of Washington, at a cost not to exceed $125,000.

(4) The establishment of experimental and bass and trout stations in the State of Maryland or West Virginia at a cost not to exceed $75,000.

Sec. 2. There are hereby authorized to be appropriated during the fiscal year beginning July 1, 1931, such amounts as may be necessary for—

(1) The establishment of a fish-cultural station in each of the following States, at a cost not to exceed the amount specified: Alabama, $50,000; Indiana, $50,000; Tennessee (in the middle division of the State), $50,000; Pennsylvania (including a substation), $100,000.

(2) The establishment of a fish-cultural substation in each of the following States, at a cost not to exceed the amount specified: South Carolina, or the enlargement of Orangeburg Station in said State, $25,000; Texas (in the western part of the State), $35,000; New York, $35,000.

(3) The purchase of Mill Creek station in the State of California, at a cost not to exceed $20,000.

(4) The purchase and repair of the Rogue River substation in the State of Oregon, at a cost not to exceed $35,000.

SEC. 3. There are hereby authorized to be appropriated during the fiscal year beginning July 1, 1932, such amounts as may be necessary for—

(1) The establishment of a fish-cultural station in the State of Florida, at a cost not to exceed $60,000.

(2) The establishment of a fish-cultural substation in each of the following States, at a cost not to exceed the amount specified: Maine (including enlargement of Craig Brook station), $50,000; Virginia (in the eastern part of the State), $75,000; Minnesota, $50,000.

(3) The establishment of a fishery laboratory in the State of Texas (on the Gulf coast of the eastern part of the State), at a cost not to exceed $75,000.

(4) The purchase or construction of a steel fish-distribution car, at a cost not to exceed $75,000.

SEC. 4. There are hereby authorized to be appropriated during the fiscal year beginning July 1, 1933, such amounts as may be necessary for—

(1) The establishment of a fish-cultural station in each of the following States, at a cost not to exceed the amount specified: Nevada, $60,000; Illinois, $75,000; New Jersey, $75,000; a fish cultural substation in Mississippi (in the southern part of the State), $50,000.

(2) The purchase or construction of a steel fish-distribution car at a cost not to exceed $75,000.

SEC. 5. There are hereby authorized to be appropriated during the fiscal year beginning July 1, 1934, such amounts as may be necessary for—

(1) The establishment of a fish-cultural substation in each of the following States, at a cost not to exceed the amount specified: Ohio, $35,000; Kansas, $35,000; North Dakota, $35,000; Georgia, $35,000.

(2) The purchase and repair of the Little White Salmon station in the State of Washington, at a cost not to exceed $35,000.

(3) The establishment of a fishery laboratory in the Territory of Alaska, at a cost not to exceed $50,000.

(4) The establishment of an experimental and bass and trout station in the Pisgah National Forest or in the Great Smoky National Park in the State of North Carolina upon the acquisition of said park by the United States, at a cost not to exceed $35,000.

SEC. 6. (a) The stations, substations, and laboratories authorized by sections 1, 2, 3, 4, and 5 shall be located in the States and parts thereof and in the Territory specified, at such suitable points as may be selected by the Secretary of Commerce.

(b) Any appropriation made under authority of sections 1, 2, 3, 4, and 5 may be expended for the purchase of sites, and the purchase of equipment, the construction of buildings and ponds, and for such other expenses as may be incidental to the cost of the establishment, purchase, or enlargement, as the case may be, of the station, substation, or laboratory in question.

(c) No part of an appropriation made under authority of sections 1, 2, 3, 4, or 5 shall be expended in the construction, purchase, or enlargement of a station or substation until the State in which such station or substation is to be located shall have by legislative action accorded to the United States Commissioner of Fisheries and his duly authorized agents the right to conduct fish hatching and fish culture, and all operations connected therewith in any manner and at any time that may by the commissioner be considered necessary and proper, any laws of the State to the contrary notwithstanding. The operation of any station, substation, or laboratory established, purchased, or enlarged under authority of this Act shall be discontinued whenever the State ceases to accord such right; and such operation may be suspended by the Secretary of Commerce whenever in his judgment State laws or regulations affecting fishes cultivated are allowed to remain so inadequate as to impair the efficiency of such station, substation, or laboratory.

(d) That the authorizations herein given in sections 1, 2, 3, 4, and 5 with reference to appropriations for certain specified years are for the purpose of indicating priority proposed to be given the various projects enumerated therein, but shall not be held to require the appropriations therein enumerated to be made in the years specified, and the appropriations enumerated are likewise authorized in prior or subsequent years in annual or supplemental appropriation Acts.

Sec. 7. There are hereby authorized to be appropriated, in addition to all other amounts authorized by law to be appropriated, not to exceed the following amounts during the fiscal years specified:

(1) For the purpose of providing adequate maintenance costs and personnel for the Division of Fish Culture, Bureau of Fisheries: Fiscal year beginning July 1, 1930, $100,000; fiscal year beginning July 1, 1931, $200,000; fiscal year beginning July 1, 1932, $300,000; fiscal year beginning July 1, 1933, $400,000; fiscal year beginning July 1, 1934, $500,000. Of each amount authorized by this paragraph to be appropriated, not more than 30 per centum is authorized for salaries at the seat of government and elsewhere.

(2) To meet the demand for fundamental knowledge regarding our great commercial fisheries and for developing the natural cultivation of oysters, mussels, and other mollusca, and the improvement of pond cultural, the encouragement of fish conservation in the waters of the Great Lakes and other waters, and other operations of the Division of Inquiry, Bureau of Fisheries, respecting food fishes, sufficient annual additions to increase present appropriations by not to exceed $300,000 per annum at the conclusion of the construction program authorized in this Act. Of each amount authorized by this paragraph to be appropriated not more than 40 per centum is authorized for salaries at the seat of government and elsewhere, and not to exceed $10,000 in any year for a survey of the fisheries of the Hawaiian Islands.

(3) To provide for the proper husbandry of our fisheries, improvements in methods of capture, merchandising, and distribution of our fishery harvest, including saving and utilization of waste products, and other operations of the Division of Fishery Industries, Bureau of Fisheries, sufficient annual additions to increase present appropriations by not to exceed $175,000 per annum at the conclusion of the construction program authorized in this Act. Of each amount authorized by this paragraph to be appropriated not more than 40 per centum is authorized for salaries at the seat of government and elsewhere.

Sec. 8. In carrying out the provisions of this Act the Bureau of Fisheries may cooperate with States, counties, municipalities, individuals, and public and private agencies, organizations, and institutions, and may accept donations of lands, funds, and other aid to the development of this program.

Approved, May 21, 1930.

BLACK-BASS LEGISLATION

The act of May 20, 1926, designed to regulate the interstate transportation of black bass, proved to be impracticable of enforcement. During the second session of the Seventy-first Congress, at the request of a congressional committee, the bureau made a careful study of the subject and aided in drafting a comprehensive corrective measure which was adopted by the Congress at the close of the fiscal year. This act will be effective on and after July 2, 1930. The act, among other things, provides in substance that it shall be unlawful for any person to deliver or knowingly receive for transportation, or knowingly to transport, any black bass, if (1) such transportation is contrary to the law of the State from which such black bass is or is to be transported, or (2) such black bass has been either caught, killed, taken, sold, purchased, possessed, or transported, at any time, contrary to the law of the State in which it was caught, killed, taken, sold, purchased, or possessed, or from which it was transported; and that no person shall knowingly purchase or receive any such black bass which has been transported in violation of the act.

The act also provides that all interstate shipments of black bass shall be clearly and conspicuously marked and show the names and addresses of the shipper and consignee; that all black bass transported into a State in interstate commerce shall be subject to the operation and effect of the laws of that State to the same extent and in the same manner as though the fish had been produced in such State, and shall not be exempt therefrom by reason of having been introduced therein in original packages or otherwise; and makes provision for the confiscation of illegal shipments of black bass, not only on conviction of the offender but upon the judgment of the court that the same were delivered, transported, purchased, or received in violation of the act.

Authority to enforce the act and to make such regulations as may be necessary to carry out its purposes is vested in the Secretary of Commerce. As soon as funds are provided by Congress steps will be taken to carry out the provisions of the act. A copy of the act follows.

[Public—No. 495—71st Congress]

[S. 941]

An Act To amend the Act entitled "An Act to regulate interstate transportation of black bass, and for other purposes," approved May 20, 1926

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Act entitled "An Act to regulate the interstate transportation of black bass, and for other purposes," approved May 20, 1926 (U. S. C., Sup. III, title 16, secs. 851–856), is amended to read as follows:

"That when used in this Act the word 'person' includes company, partnership, corporation, association, and common carrier.

"Sec. 2. It shall be unlawful for any person to deliver or knowingly receive for transportation, or knowingly to transport, by any means whatsoever, from any State, Territory, or the District of Columbia, to or through any other State, Territory, or the District of Columbia, or to or through any foreign country, any large-mouth black bass (Micropterus salmoides) or any small-mouth black bass (Micropterus dolomieu), if (1) such transportation is contrary to the law of the State, Territory, or the District of Columbia from which such black bass is or is to be transported, or (2) such black bass has been either caught, killed, taken, sold, purchased, possessed, or transported, at any time, contrary to the law of the State, Territory, or the District of Columbia in which it was caught, killed, taken, sold, purchased, or possessed, or from which it was transported; and no person shall knowingly purchase or receive any such black bass which has been transported in violation of the provisions of this Act; nor shall any person receiving any shipment of black bass transported in interstate commerce make any false record or render a false account of the contents of such shipment.

"Sec. 3. Any package or container containing such black bass transported or delivered for transportation in interstate commerce, except any shipment covered by section 9, shall be clearly and conspicuously marked on the outside thereof with the name 'Black Bass,' an accurate statement of the number of such fish contained therein, and the names and addresses of the shipper and consignee.

"Sec. 4. All such black bass transported into any State, Territory, or the District of Columbia for use, consumption, sale, or storage therein, shall upon arrival in such State, Territory, or the District of Columbia be subject to the operation and effect of the laws of such State, Territory, or the District of Columbia to the same extent and in the same manner as though such fish had been produced in such State, Territory, or the District of Columbia, and shall not be exempt therefrom by reason of being introduced therein in original packages or otherwise.

"Sec. 5. The Secretary of Commerce is authorized (1) to make such expenditures, including expenditures for personal services at the seat of government and elsewhere, and for cooperation with local, State, and Federal authorities, including the issuance of publications, and necessary investigations, as may be necessary to execute the functions imposed upon him by this Act and as may be provided for by Congress from time to time; and (2) to make such regulations as he deems necessary to carry out the purposes of this Act. Any person violating any such regulation shall be deemed guilty of a violation of this Act.

"Sec. 6. (a) Any employee of the Department of Commerce authorized by the Secretary of Commerce to enforce the provisions of this Act (1) shall have power, without warrant, to arrest any person committing in the presence of such employee a violation of this Act or any regulation made in pursuance of this Act, and to take such person immediately for examination or trial before an officer or court of competent jurisdiction; (2) shall have power to execute any warrant or other process issued by an officer or court of competent jurisdiction to enforce the provisions of this Act or regulations made in pursuance thereof; and (3) shall have authority, with a search warrant issued by an officer or court of competent jurisdiction, to make search in accordance with the terms of such warrant. Any judge of a court established under the laws of the United States or any United States commissioner may, within his respective jurisdiction, upon proper oath or affirmation showing probable cause, issue warrants in all such cases.

"(b) All fish delivered for transportation or which have been transported, purchased, received, or which are being transported, in violation of this Act or any regulations made pursuant thereto, shall, when found by such employee or by any marshal or deputy marshal, be summarily seized by him and placed in the custody of such persons as the Secretary of Commerce shall by regulations prescribe, and shall, as a part of the penalty and in addition to any fine or imprisonment imposed under section 7 of this Act, be forfeited by such court to the United States upon conviction of the offender under this Act, or upon judgment of the court that the same were transported, delivered, purchased, or received in violation of this Act or regulations made pursuant thereto.

"Sec. 7. In addition to any forfeiture herein provided, any person who shall violate any of the provisions of this Act shall, upon conviction thereof, be punished by a fine not exceeding $200, or imprisonment for a term of not more than three months, or by both such fine and imprisonment, in the discretion of the court.

"Sec. 8. Nothing in this Act shall be construed to prevent the several States and Territories from making or enforcing laws or regulations not inconsistent with the provisions of this Act, or from making or enforcing laws or regulations which shall give further protection to large-mouth and small-mouth black bass.

"Sec. 9. Nothing in this Act shall be construed to prevent the shipment in interstate commerce of live fish and eggs for breeding or stocking purposes."

Approved, July 2, 1930.

DEVELOPMENT OF FISH SCREENS AND FISHWAYS

Under the act of Congress approved May 1, 1928, the bureau was directed to determine the best means of preventing the destruction of fishes in irrigation ditches, canals, and other works. During the two years of investigation substantial progress has been made in the solution of the problem.

In the small to moderately large diversions, the most practical and economical type of mechanical fish screen consists essentially of a cylinder of heavy wire-mesh material placed in an appropriate supporting structure and made to revolve on a horizontal axis in the direction of the stream flow, the motive power being furnished by a paddle or bucket wheel placed in the ditch below the screen. In addition it is provided with the necessary by-pass channel for return of the fish to the main stream. The type found to be the most practical was that adopted by the Oregon Game Commission and the Washington Division of Fisheries.

As a result of continued experimentation, the electric fish screen for large diversions has been developed to a stage where it is successful in diverting upstream migrating fish from tailrace waters; it has been of value also for diverting downstream migrants from intakes, but further experiments are needed to increase its efficiency, simplify its design, and reduce its cost. Additional experiments should be made to determine the best type of current and the best voltage values to be specified for electric screens.

During 1928 practically all fish ladders in the States of Washington, Oregon, Idaho, and Montana were inspected and studied. Observations were made of the habits of migratory fish to discover the basic principles which should govern the design of fishways. In 1929, practical application of these principles was made in the construction of a new fish ladder at the Sunnyside Dam near Yakima, Wash., which revealed the efficiency of fish ladders of large pool design. In addition, the design of a new fish ladder for the Sprague River Dam near Chiloquin, Oreg., was begun, studies made of Canadian data on the subject, and several proposed power sites were inspected, including the study of models and designs of fish ladders for the purpose of determining more definitely the requirements at these projects. The examination of proposed power projects and the prompt giving of the specifications necessary for fish-protective structures are of vital importance. The bureau has received very helpful cooperation from Federal and State authorities, power interests, and other agencies.

UPPER MISSISSIPPI RIVER SITUATION

The upper Mississippi River situation with respect to mussels, fin fisheries, pollution, the possible effects of flood control and improvements to navigation, and the importance of properly developing the aquatic resources of the Upper Mississippi Wild Life and Fish Refuge presents a very serious and complex problem.

Only a few areas from Lake Pepin, Minn., to Quincy, Ill., are still productive of mussels in a commercial way. The evidence indicates that conditions in the Mississippi River within this area are no longer suitable for the development of the glochidia, and the mussel fishery of this region appears to be doomed to economic exhaustion. From Minneapolis to the lower end of Lake Pepin the fisheries situation is bad, the catch of fish in the lake declining from 3,572,000 pounds in 1922 to 386,000 pounds in 1929. On February 4, 1930, the metropolitan drainage commission of St. Paul and Minneapolis reported the oxygen content of the lake water as two and two-tenths parts per million at Frontenac, Minn., near the upper end of the lake, and two and seven-tenths parts per million at Lake City in the lower section. Thus in the upper end of the lake, at least, the oxygen content dropped below the safety point for the maintenance of fish life. Observations on a number of sloughs along the upper Mississippi River in Minnesota and Wisconsin show a reduction of oxygen content below the safety point. The conditions of the river cited above appear to be due largely to the joint action of pollution and erosion silt.

Conservationists have stressed the possible dangers to aquatic life which may occur through changed conditions resulting from the construction of dams and the dredging of deeper navigation channels in this area, and have urged that arrangements be made so that biologists of the Bureaus of Fisheries and Biological Survey will be afforded cooperative arrangements for the purpose of calling attention to these potential dangers and suggesting the need for remedial changes. For example, sudden changes in water level may prove very destructive to fish life and detrimental to the birds and mammals of the region. This may impair the value of the Mississippi Wild Life and Fish Refuge, as well as nullify the compacts entered into with the Legislatures of Minnesota, Iowa, Wisconsin, and Illinois and ratified by Congress.

The bureau has reorganized its staff of biologists and rearranged its program of investigations in this upper Mississippi River area to reveal with greater definiteness the conditions which obtain and the steps necessary to restore the productivity in mussels and fish. It has cooperated also with the Engineer Corps of the Army in considering plans of improvement of navigation to provide more stable conditions and, if possible, to improve the situation with respect to wild life and fish.

SPECIAL SENATE COMMITTEE ON WILD LIFE RESOURCES

On April 17, 1930, there was appointed (under S. Res. 246) a special committee of five Senators to investigate all matters pertaining to the replacement and conservation of wild life with instructions to report its findings to the Senate as soon as possible. The studies have to deal with a vast range of subjects, including the fishes of the Atlantic, Pacific, Gulf, and inland waters, and the fur-seal and fishery industries. At the conclusion of its exhaustive studies, which will extend over a period of more than a year, the committee plans to recommend to the United States Senate any changes or additions that they consider necessary in or to existing laws pertaining to conservation.

ALASKA FISHERIES SERVICE

ADMINISTRATION OF FISHERY LAWS AND REGULATIONS

Under the White fisheries law of June 6, 1924, which virtually gives the Secretary of Commerce authority to prescribe when, where, and how commercial fishing may be conducted in the waters of Alaska, steady progress has been made toward stabilizing the fisheries industry—the most important economic resource of the Territory. While regulations will not prevent fluctuations resulting from conditions that can neither be foreseen nor controlled, the results achieved in the six years since the passage of this act leave no room for doubt as to the value of the conservation measures that have been in effect during that time.

Of primary importance in preventing depletion of the fisheries is the securing of an escapement sufficient for the adequate seeding of the spawning beds. This is brought about by means of weekly closed periods and closed seasons during which all commercial fishing ceases, by limitation on the quantity and kind of gear that may be used, and by the establishment of closed areas wherein commercial fishing is prohibited. Such control necessitates constant observation of conditions in all districts throughout the fishing season so that prompt modifications may be made in existing regulations to meet unforeseen developments with respect to the volume of the runs.

Coincident with the enforcement of regulations to assure the escapement of at least 50 per cent of the salmon runs is the work of removing log jams and other barriers that prevent the fish from ascending the streams. Predatory enemies of the salmon are destroyed where it appears that their depredations are taking an undue toll of the young fish. Material assistance was given by the Territorial legislature in 1929 through the appropriation of $40,000 for these purposes.

In 1929, 12 statutory and 216 temporary employees were engaged in the patrol of the fishing grounds in addition to the crews of 14 vessels belonging to the bureau and 10 chartered vessels. Many of the temporary employees provided their own launches. An airplane was used experimentally for the first time in connection with the fisheries patrol in southeastern Alaska, and the advantages of aircraft as an auxiliary patrol were demonstrated.

During the active salmon-fishing season the Commissioner of Fisheries spent several weeks in Alaska, including a visit to the Pribilof Islands, keeping in close touch with all important matters pertaining to the fisheries industry. Modifications of existing regulations were made on his recommendation from time to time as the season advanced. On December 19, 1929, revised regulations to be effective in the following calendar year were issued.

ALASKA SALMON HATCHERIES

At the Government hatcheries at Afognak and on McDonald Lake 38,095,120 red-salmon eggs, 2,650,000 pink-salmon eggs, and 150,000 steelhead-trout eggs were collected in 1929. From these collections, shipments of 4,553,200 red-salmon eggs and 1,021,000 pink-salmon eggs in the eyed stage were forwarded to Seattle in October. At the privately owned hatchery operated under the provisions of the Alaska fisheries act of June 26, 1906, 11,760,000 red-salmon eggs were collected.

SPECIAL STUDIES AND INVESTIGATIONS

An important factor in the conservation of the fisheries is the securing of scientific knowledge of the life history and habits of the various species. This work was continued in Alaska during 1929. A detailed discussion of the various activities will be given later in this report.

Weirs for counting the numbers of salmon ascending to the spawning grounds were maintained in 20 typical salmon streams, of which 6 were in southeast, 12 in central, and 2 in western Alaska. Through the operation of such weirs the ratio of escape to catch is established and valuable information is acquired as to the probable return from a known escapement. Observations of the condition of the spawning grounds were made in all districts.

PRODUCTS OF THE FISHERIES

In 1929 salmon products, which comprise upward of 80 per cent in value of the Alaska fishery products, amounted to 272,244,435 pounds valued at $42,524,845. This is somewhat less than the output for the preceding year when 308,691,203 pounds of salmon products valued at $47,487,763 were prepared; but it compares favorably with the average of approximately 265,570,000 pounds, valued at $39,312,586, for the 5-year period from 1924 to 1928, inclusive. About 95 per cent of the salmon products in 1929 consisted of canned salmon, the pack amounting to 5,370,159 cases valued at $40,469,385.

The quantity of herring products exceeded that of any preceding year except 1925, but a large percentage consisted of meal and oil because of the unusually small size of the fish taken. The value of the herring products was the lowest since 1924. There was a considerable increase over the previous year in the amount and value of the halibut taken by the Alaskan fleet. Whaling was conducted on about the same scale as in recent years. Of the several minor fisheries, the output of clams showed the greatest increase.

The total value of all fishery products of Alaska in 1929 was $50,795,819, as compared with $54,545,588 in the preceding year and an average of $45,941,358 for the 5-year period from 1924 to 1928, inclusive. Of this total, $42,524,845 represented the value of the salmon output; $4,422,605, halibut; $2,794,084, herring; $502,081, whale products; $203,656, clams; $200,312, shrimps; and $148,236, miscellaneous fishery products. The value of the catch to the fishermen was approximately $16,582,000, or about $761,000 less than in the preceding year. There were 29,283 persons employed in the various branches of the industry, as compared with 31,086 in 1928.

The extent and condition of the Alaska fisheries in 1929 and of the activities of the bureau under the laws and regulations for the protection of the fisheries are covered in detail in the annual report of the Alaska service for that year.

ALASKA FUR-SEAL SERVICE

GENERAL ACTIVITIES

The Government management of the Pribilof Islands fur-seal herd, under conditions brought about by the North Pacific Sealing Convention of 1911, has resulted in a gradual and steady increase in the number of animals, making it possible to secure more pelts of surplus males in successive seasons without detriment to the growth of the herd. The increase in the annual killings has given rise to the question of more profitable disposition of the seal carcasses—the main utilization of which heretofore has been as food for the fox herds on the islands, although some reduction of meal and oil has been accomplished at various times. Accordingly, the erection of a modern by-products plant was begun in the early summer of 1930.

Under the direction of the bureau's staff of employees, sealing operations on the Pribilof Islands are performed by the natives. The upkeep and replacement of buildings and the extension of improved roads are given due attention each year, the work being carried on chiefly when sealing activities are not pressing. The care and feeding of the blue-fox herds on St. Paul and St. George Islands provide additional occupation during the winter. In return for their services the native population, consisting of 368 persons, are furnished food, clothing, and shelter, as well as schools and medical aid. Further compensation is made in cash at the rate of 75 cents for each sealskin and $5 for each fox skin taken, with some additional payments for special services.

The need of a new vessel to serve as tender for the Pribilof Islands had been felt for some time, the *Eider* having become inadequate both by reason of its limited capacity and because of its long service in the exposed waters of Bering Sea. A new power vessel, *Penguin*, designed especially for such service, was built in the fiscal year 1930 and is proving to be well adapted for the duties required. The *Penguin* sailed from Seattle on May 5 on its maiden voyage to the islands, carrying seasonal employees of the bureau and about 185 tons of supplies.

Through the cooperation of the Navy Department the annual supplies for the Pribilof Islands were transported from Seattle, Wash., on the U. S. S. *Sirius*, and the sealskins and fox skins then ready for shipment were brought back on the return voyage.

SEAL HERD

The computed number of animals in the Pribilof Islands fur-seal herd on August 10, 1929, was 971,527—an increase of 100,014, or 11.48 per cent, over the corresponding figure for 1928.

TAKE OF SEALSKINS

In the calendar year 1929 there were taken on the Pribilof Islands 40,068 fur-sealskins, of which 33,216 were from St. Paul Island, and 6,852 from St. George Island. This was an increase of 8,969 over the number taken in 1928 and is the largest take of any year since 1889.

MARKING RESERVED SEALS

In 1929 the number of 3-year-old male seals marked for the breeding reserve was 8,085, of which 6,430 were on St. Paul Island, and 1,655 on St. George Island. The marking was done by shearing a patch of fur, and on St. Paul Island 200 of the animals so marked were also branded with a hot iron.

SALE OF SEALSKINS

Two public auction sales of fur-seal skins taken on the Pribilof Islands were held at St. Louis, Mo., in the fiscal year 1930. The first was on September 30, 1929, when 5,022 black-dyed and 9,000 logwood brown-dyed skins were sold for a gross price of $349,648. At the same time 142 logwood brown-dyed and 10 raw-salted Japanese fur-seal skins brought $3,486.50. These 152 skins were the United States Government's share of sealskins taken by the Japanese Government in 1928. In addition, 2 confiscated fur-seal skins, dyed logwood brown, were sold for $33, and 5 confiscated sea-otter skins were sold for $963.

At the second sale, held on April 7, 1930, 8,011 black-dyed and 6,035 logwood brown-dyed skins were sold for $319,290, and 4 confiscated skins (2 dyed logwood brown, 1 dressed in hair, and 1 raw salted) brought $16.50.

Special sales of sealskins, authorized by the Secretary of Commerce, in the fiscal year 1930 consisted of 125 black-dyed and 75 logwood brown-dyed skins at a gross price of $8,807.86. All were taken at the Pribilof Islands.

FOXES

The care of foxes on the Pribilof Islands is incidental to sealing operations, requiring attention only during the winter months.

Five hundred and forty-four blue and nine white fox skins taken in the season of 1928–29 were sold at public auction on September 30, 1929. The blue pelts brought $35,865 and the whites $556, a total of $36,421.

In the season of 1929–30, 193 blue and 31 white fox skins were taken on St. Paul Island and 552 blues and 1 white on St. George Island, a total of 777 skins. Seventy-two foxes on St. Paul Island and 546 on St. George Island were trapped, marked, and released for breeding purposes. Additional foxes, not caught in the traps, were also included in the breeding reserve.

FUR-SEAL SKINS TAKEN BY NATIVES

The privilege of taking fur seals at sea under specified limitations is granted to natives of the Pacific coast by the provisions of the North Pacific Sealing Convention of July 7, 1911. Before the sealskins can enter into commerce they must be authenticated as having been lawfully taken. One thousand five hundred and eighty-six fur-seal skins taken in 1929 have been authenticated by the Government, 995 of which were taken in the offshore waters of southeastern Alaska and 591 in waters off the coast of Washington. Through the courtesy of the Department of the Interior, the latter skins were authenticated by the superintendent of the Neah Bay Indian Agency. An official report stated that 3,383 fur-seal skins were taken by natives of British Columbia in 1929.

FUR-SEAL PATROL

As in previous years, a patrol for the protection of the fur seals and sea otters in the waters of the North Pacific Ocean and Bering Sea was maintained by vessels of the United States Coast Guard. Two of the bureau's vessels were likewise engaged in the fur-seal patrol during the spring migration of the herd.

Under date of September 24, 1929, there was issued a revised (second) edition of the circular containing the laws and regulations for the protection of fur seals and sea otters, which embodied the Executive order of January 14, 1929, naming each of the bureau's vessels in the Alaska service as authorized to take part in the fur-seal patrol.

PROTECTION OF SEA OTTERS, WALRUSES, AND SEA LIONS

Revised regulations for the protection of walruses and sea lions were issued as of May 1, 1930, extending the closed season on these animals for another 2-year period. Permission to kill the animals under certain restricted conditions previously set forth was continued. The killing of sea otters is prohibited at all times.

BIOLOGICAL FISHERY INVESTIGATIONS

The division of scientific inquiry during the fiscal year 1930 continued biological investigations of the fisheries intended to promote the conservation activities of the various States, to foster and encourage aquiculture, and to aid industry in the proper utilization of aquatic food resources. The division's most important function is the acquiring of fundamental knowledge of the fisheries—marine, commercial, fresh-water, or sports—to serve as the basis for so regulating the take that an adequate breeding stock will be maintained, assuring continued productivity of the supply. In addition to prohibitory or regulatory recommendations, investigations are conducted as a means of increasing the output of the hatcheries and of more wisely directing the planting and stocking system. Studies have also been conducted on the problem of increasing the productivity of natural water areas and on fish farming in small lakes and ponds.

Major projects of research are conducted in each of the geographical sections and coasts of the United States and the more important interior waters, covering some 28 important commercial and game fishes, as well as studies of organisms related to these species either as food or as enemies.

Outstanding progress has been made in the aquicultural investigations that are concerned primarily with increasing the output of hatcheries and the stocking of interior waters with food and game fishes. Of more direct benefit to the commercial fisheries are the investigations on shellfish culture, particularly in the farming of oyster bottoms and in the investigation of the commercial fisheries of the North Atlantic. A most direct method of conservation of the salmon of the Pacific Coast States is preventing the destruction of millions of young salmon entering irrigating canals while migrating to the sea from the spawning places in the headwaters of the rivers. The bureau's installations of experimental screens at the mouths of irrigating ditches are proving particularly effective.

AQUICULTURAL INVESTIGATIONS

The division's fresh-water investigations in aquiculture are included under four headings: Experimental trout culture, experimental bass culture in ponds, experimental fish culture in the Upper Mississippi River Wild Life and Fish Refuge, and studies on the pathology of hatchery fish. Several years' experiments in the use of various substitutes for fresh meat in the diet of brook trout have culminated in the adoption of an ideal ration that includes dry meals with the regulation beef liver and beef heart diet in sufficient quantities to reduce the total cost of feeding by about 50 per cent. These perfected rations not only produce excellent growth in the fry and fingerlings but reduce mortality to a minimum and permit the holding of trout at hatcheries until greater size is reached before planting. Experiments on selective breeding are also under way that give promise of producing a superior strain of brood stock that is rapid growing, disease resisting, and above the average in egg production.

At the bureau's pond-culture station, experiments on the rearing of black bass have been equally successful. Better and more efficient methods have been devised for propagating and rearing the warm-water game fishes, such as the large and smallmouth black bass, the white and black crappie, and the bluegill sunfish. By the proper use of minnows as forage fish and by the fertilizing of ponds with commercial and chemical fertilizers, the bureau has produced as high as 11,500 fingerling bass per acre, and one of its ponds has averaged 8,500 per acre for three years.

In the Upper Mississippi Wild Life and Fish Refuge a number of sloughs and ponds in the overflowed lowlands of the river valley have been prepared for intensive fish production, and detailed limnological observations on the abundance of fish and the character of fish food available in the area have been made. One of the most serious difficulties in fish culture of the region is due to the rank growth of aquatic vegetation. Chemical treatments have been devised which will destroy the coarser plants without injury to the fish or interference with the food supply. Such treatments are being applied to the ponds in the refuge and will have practical application to pondfish culture throughout the country.

The bureau's pathologist has continued his studies on the diseases of trout and has rendered invaluable service not only to the bureau's hatchery superintendents through the diagnosis and treatment of disease in hatcheries, but to many State and private fish-culturists. This line of work is so productive that plans are laid for its expansion as rapidly as funds will permit.

FISHERIES OF THE ATLANTIC AND GULF COASTS

Fundamental studies on the factors that affect the abundance of fish in the great commercial fisheries of the Atlantic seaboard have been undertaken during the past two years with the aid of the fisheries steamer *Albatross II* and a staff of shore observers. Studies of the chemical and physical condition of the water and its contained floating life have been made at various seasons of the past year in order to judge the success of spawning of various important species and the influences that control their migrations. A comprehensive report on the migrations and biology of the cod of southern New England is now in press, and rapid progress has been made on studies of the stock of mackerel. The erratic appearance and disappearance of huge stocks of mackerel in Atlantic waters is now known to be due to variations in actual abundance resulting from the occurrence of successful spawning at fairly infrequent intervals, and it has been possible to predict with increasing accuracy the commercial runs of the following season.

Investigations of the shore fisheries of southern New England and the Middle Atlantic States, begun two years ago, indicate that similar causes control the abundance of other important species and that the decline in productivity of the squeteague, or weakfish, in recent years is the result of natural rather than artificial causes.

Much of the understanding of the biology of these food fishes depends upon a knowledge of their early life history. A deliberate attack upon this problem has been made in connection with the oceanography of the North Atlantic region by extensive collection and study of the eggs and larvæ obtained in the surface waters and in a program of collections in the South Atlantic region at the Beaufort biological station.

On the Gulf coast, studies of the fauna have been continued with the aim of eventually producing a manual of the marine fishes that will give descriptions of the species and the pertinent facts in their life history, habits, and economics.

FISHERIES OF THE PACIFIC COAST AND ALASKA

Investigation of the commercial fisheries of the Pacific coast and Alaska have been restricted to the salmon runs of Alaska, to the completion of salmon-tagging experiments on the Columbia River, and continuation of the Alaska herring studies. New investigations during the year included a study of the homing instinct of pink salmon in Alaska, an investigation of the red salmon of the Copper River, and a study of the red-salmon runs of the Bristol Bay district. The compilation and analysis of the statistics of the salmon fisheries of central Alaska were completed during the year. Intensive investigations of the red-salmon run of the Karluk River were continued as a part of the general program of determining the normal return from known escapements of spawning fish.

In the Chignik River, the Copper River, and in certain sections of Bristol Bay similar investigations are under way. In undertaking an investigation of the pink salmon in southeastern Alaska, the most pressing problem was the early settlement of the question of the relative strength of the homing instinct in this species. Forty-six salmon streams were visited and data collected.

Field work on the Columbia River was restricted to the recovery of mature fish that had been marked years before as fingerlings to determine how long the fingerlings should be held at hatcheries before planting. The experiment further substantiated the parent stream theory, but failed to indicate any advantage of one age of liberation over another.

The bureau has published a very complete report on the herring fishery of Alaska, in which the occurrence of distinct racial units in the stock is demonstrated and the relation of catch composition to fluctuations in abundance with a summary of the evidence of depletion is presented.

FISHERIES OF THE GREAT LAKES

Investigations of commercial fisheries of Lake Erie and Lake Huron were continued. The study of the relative destructiveness of gill nets and trap nets of various sized meshes was completed and served as a basis for the new regulations passed in Ohio. They also served as a basis for the revision of the commercial fisheries laws in Michigan and Indiana, and for recommendations offered to Wisconsin, Minnesota, and New York. As a result of the bureau's continued effort, all the States bordering the Great Lakes except Minnesota have now introduced the recommended method of collecting fishery statistics showing the daily catch together with the amount of gear employed.

Cooperative investigation of the limnology of Lake Erie to discover normal conditions favoring fish growth as well as possible effects of pollution or other factors limiting fish production, undertaken jointly by the bureau and the States of Ohio and New York and private institutions, was completed during the year, and data are being compiled and analyzed. In addition, the bureau cooperated directly with the Ohio division of fish and game in conducting an intensive limnological investigation of the western end of Lake Erie in connection with the studies on the distribution of larval and postlarval fish and the possible effects of pollution.

INTERNATIONAL INVESTIGATION OF THE LAKE CHAMPLAIN FISHERY DISPUTE

Personnel of the Bureau of Fisheries cooperated with Canadian investigators in an investigation of the fisheries of Lake Champlain to settle the dispute between the sportsmen of the United States and the commercial fishermen of Canada, all of whom exploit the pike perches as sports fishes in the United States waters and as a commercial fishery in the Missisquoi Bay region of Quebec. The chief features of the biology of these species will be determined in order to judge the interdependence of the waters on both sides of the international boundary in the hope of reaching an amicable settlement of this old controversy.

SHELLFISH INVESTIGATIONS

Oysters.—Oyster investigations during the past year consisted in the experimental study of oyster culture in New England, Georgia, Texas, and Washington, in a study of the physiology of adult and larval oysters, in a study of the effect of pulp-mill waste on oysters of the Puget Sound, and in an investigation of the biology of the natural enemies of the oyster such as the oyster drill and starfish. Several years' investigations of the oyster fishery resulted in a number of publications recently issued. Much interest has been aroused in the oyster industry by the development of a new and more efficient type of oyster spat collector, consisting of a cement-coated paper crate resembling egg crate partitions, with the result that this method of increasing seed oyster production is being generally adopted by the industry.

Studies of oyster culture in lower Puget Sound, begun last year, indicated that the beds in Oakland Bay were being destroyed. A hydrobiological and a physiological investigation was undertaken to determine the cause of this failure. Laboratory tests showed that waste sulphite liquor from a pulp mill in the vicinity would kill oysters or interfere with their feeding activities. On the basis of calculations of the amount of liquor dumped into the bay during the past two years and from tidal studies it is estimated that the bay contained sulphite liquor in sufficient concentration to produce such toxic effects. A preliminary report was prepared in which it was recommended that sulphite liquor be excluded from waters in which oysters are produced.

Studies on the control of starfish pests on the oyster beds of Long Island Sound give promise of developing an efficient treatment for killing the starfish soon after the spawning of these animals in the spring by means of copper sulphate. Because of the practical importance of this work the investigation will be continued.

Fresh-water mussels.—Investigations of improved methods of mussel culture were continued during the early part of the fiscal year. A thoroughly successful laboratory method for artificial propagation of the valuable fresh-water mussels has been hindered in large-scale production by the extensive pollution of the upper Mississippi River system. An extensive survey of the waters of Arkansas, Louisiana, Texas, and northern Mexico, as well as tributaries of the Mississippi farther north, was undertaken to discover areas suitable for the extension of mussel culture, and a systematic effort was made in the spring of 1930 to secure a breeding stock free from the effects of pollution and suitable for obtaining spawn for incubation.

The scientific staff engaged on these problems has been reorganized, field headquarters have been established at the University of Missouri, Columbia, Mo., and experiments have been undertaken to test the suitability for artificial culture of mussels from widely spread localities.

A study of the effects of pollution upon the fresh-water mussel and a survey of the streams in the Middle West yield information of direct value in stocking these waters with food and game fishes, and it is intended to expand activities in this direction as rapidly as funds will permit.

STATISTICAL SURVEYS

The statistical work of the division of fishery industries included the collection and dissemination of biological and trade-fishery statistics. Further progress was made toward the collection of annual statistics of the entire country by greater cooperation with State fishery agencies and by the use of automobiles by agents. As a result, catch statistics for 1928 were obtained for the fisheries of the New England, South Atlantic, Gulf, Pacific Coast, and Great Lakes States.

MANUFACTURED PRODUCTS

Canned products.—During 1929, 497 establishments were engaged in the canning of fishery products in the United States and Alaska. The total production amounted to 689,446,781 pounds net weight, valued at $101,065,055. This is an increase of 5 per cent in value compared with the respective value of the production in 1928. Salmon canned on the Pacific coast, mainly in Alaska, accounted for 6,990,682 standard cases (335,552,736 pounds), valued at $56,085,697. This is 55 per cent of the total value of all products canned in 1929. Sardines with a production of 5,857,016 standard cases (234,543,345 pounds), valued at $18,894,943, accounted for 19 per cent of the total value. Sardines were canned in California, Maine, and Massachusetts. Tuna and tunalike fishes with a production of 1,504,306 standard cases (36,103,344 pounds), valued at $9,873,453, accounted for 10 per cent of the value. Tuna and tunalike fishes were canned only in California. The remainder of the production consisted principally of shrimp, oysters, clam products, and mackerel.

By-products.—During 1929 by-products of the fisheries worth $23,767,656 were manufactured. The most important were 15,353,057 gallons of marine-animal oils, with a value of $6,801,619; 142,681 tons of marine-animal meals and scrap with a value of $6,801,362; fresh-water mussel shell products, such as buttons and novelties, valued at $6,144,515; and 334,766 tons of oyster-shell products, such as lime and crushed shell for poultry, valued at $2,524,499. The remainder, valued at $1,495,661, consisted of such commodities as herring skins and scales, shark skins and fins, fish flour, agar agar, glue, and various miscellaneous products.

FROZEN FISH

In 1929 there were 122 plants in the United States and Alaska freezing fishery products and 168 cold-storage warehouses which stored frozen-fishery products. The quantity of fish frozen amounted to 121,542,589 pounds, with an estimated value in the cold-storage warehouses of $15,000,000. The average monthly holdings amounted to 55,900,000 pounds in 1929, or 17 per cent over the 5-year average of monthly holdings. The freezing plants are capable of packing about 3,617,000 pounds of frozen fish per working day, and the cold-storage warehouses are capable of holding a maximum of 209,660,000 pounds of fishery products at one time.

PACKAGED FRESH, FROZEN, AND SMOKED FISH

Packaged fresh, frozen, and smoked fish were produced in 112 plants (27 more than in 1928) operated in 12 States. The output amounted to 84,396,505 pounds, valued at $14,812,987, which represents an increase of 29 per cent in amount and 51 per cent in value when compared with the trade in 1928. It is estimated that 212,000,000 pounds of whole round fish were utilized.

FOREIGN FISHERY TRADE

The value of the United States foreign trade in fishery products during 1929 amounted to $90,395,769, of which $66,565,599 represents the value of imports for consumption and $23,830,170 the value of exports. Compared with the previous year, this is an increase of 13 per cent in total trade, in the value of the imports, and in the value of the exports, respectively.

NEW ENGLAND STATES

In 1929 the fisheries of Maine, New Hampshire, Massachusetts, Connecticut, and Rhode Island employed 16,659 fishermen, or 11 per cent more than in 1924. The catch amounted to 603,598,050 pounds, valued at $25,619,904. This is an increase of 48 per cent in the catch and 36 per cent in value of the catch as compared with the quantity and its value in 1924.

Vessel fisheries.—In 1929 landings of fish by American vessels at Boston and Gloucester, Mass., and Portland, Me., amounted to 327,096,327 pounds as landed, valued at $13,051,704, and were larger than the amount and value of the landings for any one year for which there are records. Of this amount, 187,203,733 pounds were haddock.

Mackerel fishery.—The mackerel fishery showed a sharp recovery from the decline in 1926 to 1928. The total catch amounted to over 46,000,000 pounds and was 49 per cent greater than the previous year. The gain was due to the appearance of a new year class, which furnished nearly 21,000,000 pounds of small mackerel.

Packaged-fish trade.—Packaged-fish trade in New England, centering at Boston and Gloucester, Mass., and Groton, Conn., expanded during 1929, and the increased production over 1928 was about 50 per cent.

Canned sardines.—The sardine canners in Maine and Massachusetts packed 2,025,801 standard cases, valued at $6,897,946 during 1929. Production was about the same as in 1928, but the value was considerably less.

MIDDLE ATLANTIC STATES

According to the latest general canvass of the fisheries of these States (New York, New Jersey, Pennsylvania, and Delaware) made for 1926, the situation can not be considered as giving reasons for optimism as the production of many of the staple fish showed heavy declines as compared with 1921. Landings of fish at New York City and Groton, Conn., amounted to 75,325,000 pounds in 1929. This is somewhat more than in 1928. The production of menhaden in 1929 was somewhat under that for 1928.

Shad fishery.—On the Hudson River the shad fishery was carried on by 241 fishermen and yielded 56,480 shad which weighed 196,745 pounds, valued at $30,683 to the fishermen. This represents a decline of 29 per cent both in number and value as compared with the production in 1928.

CHESAPEAKE BAY STATES

The Virginia menhaden industry recovered somewhat from the poor year of 1928, and produced a larger quantity of scrap and meal, but the value barely exceeded that for 1928. There was a smaller oil production selling at a lower price in 1929 than in 1928, with the net result that the total value of the menhaden industry in Virginia in 1929, in spite of increased production, was about the same as in 1928. This situation reveals the need for improved methods in the manufacture of menhaden meal and oil with a view toward the production of a higher quality product.

Conditions in the oyster industry were little changed, although distribution has not yet kept pace in some parts of the country. The crab industry had one of its best years in 1929, according to the reports of persons in the trade. The production of packaged fish in 1929 about equaled that for 1928.

Shad fishery.—In 1929 shad and alewife fisheries of the Potomac River were prosecuted by 773 fishermen. It yielded 317,253 fish that weighed 1,052,284 pounds, valued at $141,589 to the fishermen. Compared with the yield for 1928 this is a decrease of 56 per cent in number, 49 per cent in weight, and 34 per cent in value.

SOUTH ATLANTIC STATES

In 1928 the fisheries of North Carolina, South Carolina, Georgia, and the east coast of Florida employed 11,882 fishermen, or 3 per cent more than in 1927. The catch amounted to 258,440,435 pounds, valued at $6,027,154, which is a decrease of 1 per cent in catch and an increase of 6 per cent in value when compared with 1927.

The production of canned shrimp in 1929 was somewhat higher than in 1928. The menhaden industry, which is rapidly becoming a factor in the fisheries of these States, showed a considerably increased production in 1929 over that in 1928.

GULF STATES

According to available records for 1928, the fisheries of Alabama, Mississippi, Louisiana, Texas, and the west coast of Florida have been exceeded only in 1927, from which year they decreased 2 per cent in amount and 1 per cent in value. They employed 16,356 fishermen, or 8 per cent more than in 1927. The catch amounted to 191,007,176 pounds, valued at $9,866,263. The production of canned shrimp in 1929 was about the same as in the previous year, while the production of canned oysters was considerably in excess of the pack in 1928.

Florida sponge fishery.—In 1929 the quantity of sponges sold on the exchange at Tarpon Springs, Fla., amounted to 378,514 pounds, valued at $706,645. This is a decrease of 8 per cent in quantity and 3 per cent in value compared with the transactions in 1928.

PACIFIC COAST STATES

In 1928 the fisheries of Washington, Oregon, and California produced 693,484,447 pounds of products, valued at $20,512,772. Compared with 1927 this is a gain of 6 per cent in the quantity of the catch and a decrease of 8 per cent in its value. In making the catch 19,733 fishermen were employed, which is 4 per cent less than the number employed in 1927.

In 1929, a good year, the pack of salmon was 92 per cent greater than the previous year, the larger pack of humpback or pink salmon in Puget Sound constituting most of the increase. Compared with 1927, the previous "good" year, there was an increase of 8 per cent in the pack.

The pack of sardines in California was the largest on record, both in quantity and value, and amounted to 3,831,215 standard cases valued at $11,996,997, which is an increase of 38 per cent in quantity and 24 per cent in value, compared with 1928. The production of canned tuna in 1929 was the largest on record and amounted to 1,504,306 standard cases valued, at $9,873,453. This is an increase of 24 per cent in quantity and 18 per cent in value over the pack of the previous year.

The mackerel canning industry in California continued to expand in 1929, the production amounting to 592,451 standard cases, valued at $2,428,058. This is an increase of 52 per cent in quantity and 50 per cent in value when compared with the pack during 1928.

Halibut fishery.—In 1929 the total weight of the catch of halibut as landed by United States and Canadian vessels amounted to 55,490,000 pounds, valued at $6,698,000. This is about the same as the amount of the catch in 1928, but a little more than for the years 1925 to 1927. Of the total landings 84 per cent were taken by United States craft and 16 per cent by Canadian craft.

LAKE STATES

In 1928 the lake fisheries (Lakes Ontario, Erie, Huron, Michigan, Superior, and Namakan, Lake of the Woods, and Rainy Lake) of the United States and Canada produced 92,913,909 pounds of fish. Of the total, the United States accounted for 63,368,467 pounds, valued at $5,960,784. This is the smallest catch on record and the decrease can not be attributed to a decline in the catch of any one species, for practically all show a decline compared with their respective catches for 1927. The catch of ciscoes revealed the most serious decline; that in the United States in 1928 barely exceeding 600,000 pounds compared with a catch of about 35,000,000 pounds in 1918. A decrease occurred in the catch of every lake except Ontario. The Canadian catch amounted to 29,545,442 pounds, which is slightly less than the catch in 1927. The declining yields in the lake fisheries should prove an incentive to the various State authorities and the fishermen to promulgate wise conservation measures for preventing further decline in this important resource.

MISSISSIPPI RIVER AND TRIBUTARIES

The yield of fresh-water mussel shells in 1929, used in the manufacture of pearl buttons and novelties, amounted to 54,352,000 pounds valued at $1,324,919. This is a decrease of 6 per cent in quantity and an increase of 4 per cent in value compared with the production and its value in 1922. The pearl-button industry, centering in Iowa, manufactured pearl buttons and various novelties from fresh-water mussel shells, to a value of $6,144,515 in 1929. The fisheries of Lakes Pepin and Keokuk show decreased yield in 1929 compared with that in 1928.

TECHNOLOGICAL INVESTIGATIONS

The division's technologists have been conducting research mainly on problems relating to the manufacture of fish meal and oil, the feeding value of marine products, the handling and transportation of fresh and frozen fish, and the preservation of nets.

NET PRESERVATION

In the study of trap-net preservation, selected new treatments have been tested on trap-net and gill-net threads in many fishing waters throughout the country. As a result certain essential principles of preservation applicable to all localities have been established.

Technical development of gill-net preservatives has followed scientific study. Several fishermen have used gill nets treated with brown or green colored preservatives with results comparable to the fishing power of white nets.

BY-PRODUCTS

Menhaden.—The bureau's technical study of the menhaden industry included the determination and evaluation of the losses of material encountered in the reduction process and studies of methods applicable to the present process whereby such losses could be reduced. The various recovery methods studied indicate that either all or a considerable portion of press-liquor losses may be recovered at a profit. The same is true of the oil now lost. Studies on methods of drying press cake show that present dryer losses may be reduced over one-half by drying in a high-capacity steam dryer, and the resultant dried material is of better quality and has a greater nutritional value. Studies also indicate that a considerable reduction in the cost of raw material would result from proper storage conditions aboard vessel.

Reduction of waste from nonoily fish.—Studies on the reduction of this type of material show that it may be reduced in one operation with some success if dried under reduced pressure. Most desirable results were obtained by reducing the size of the initial charge and having scraping blades on the agitator come in direct contact with the dryer walls.

Waste fish and sharks.—Studies on the utilization of waste fish and sharks in amounts too small to warrant investment in mechanical reduction equipment, show that such material may be reduced from the raw state by acidulation and solar drying. By this simple procedure, many fishermen without any considerable effort or expense can realize a profit from material that is now little more than a nuisance.

NUTRITIVE VALUE OF FISHERY PRODUCTS

Research in the nutritive value of fishery products has consisted of the following: (1) A joint study by this bureau and the Bureau of Chemistry and Soils of the Department of Agriculture of the vitamin potency of fish oils involving results of considerable interest to both the agricultural and fishery industries recently completed; (2) completion of a series of experiments at Johns Hopkins University involving the study of fish meals of different varieties and methods of manufacture on a comparative basis and as sources of animal protein; (3) practical feeding tests in which various kinds of fish meals and shellfish meals are being fed in the rations of dairy cows; (4) continuance of cooperation with the Bureau of Chemistry and Soils in the study of vitamins in oysters and in fish meals; and (5) cooperative practical feeding tests conducted by various Federal and State agricultural experiment stations in which the feeding value of marine products is being studied.

IMPROVED HANDLING OF FRESH AND FROZEN FISH

Several methods are being tried for the prevention of "rust" on frozen fish in cold storage. Preliminary work seems to indicate that some of these may prove satisfactory.

Methods for the prevention of losses incurred in weight and food and mineral values of fish packed in contact with crushed ice are being studied.

The bureau's agent in Boston has suggested the use of a platform for unloading the vessels at the fish pier to eliminate forking and excessive labor; the use of an improved filleting table in the packing houses; insulation of the holds of vessels; and improved methods for preserving cod livers aboard vessel.

OYSTER MARKET SURVEY

During 1929 the bureau conducted a survey of the wholesale and retail marketing of oysters. This was made in cooperation with the Oyster Growers and Dealers Association of America (Inc.) and certain State officials.

In this survey 1,393 housewives and 127 dealers were visited in 14 cities in 13 States in the section of the country east of the Rocky Mountains. Of the consumers interviewed it was found that 86.8 per cent use oysters from 1 to 122 times per year. The average per capita consumption in all the cities surveyed was found to be 4.2 pounds annually. The most popular size of container was found to be 1 pint. Friday was found to be the busiest day of the week and December was the busiest month of the season for the sale of oysters.

PROPAGATION AND DISTRIBUTION OF FOOD AND GAME FISHES

The summary of output of fish and eggs from the various fish-cultural stations constitutes a source of gratification in that a new high record has again been established. The total of 7,570,482,300 shows an increase of almost 500,000,000 over the production for 1929. While the increase is very largely accounted for by an augmented output of marine forms, the eggs of which are available in tremendous quantities, there was also an increase in practically all the game varieties and certain of the other commercial forms. It is noteworthy that the production of most varieties was held close to previous levels despite a marked increase in the output of fingerling or larger fish, which require extended space and normally reduce the numerical output of the hatcheries. The output of fingerlings for 1930 was

250,170,300, representing an increase of practically 85 per cent over that of the previous year. The following tabulation indicates the production of the various groups of species:

Summary of output

Game species	205, 147, 000
Commercial species (interior waters)	524, 120, 900
Commercial species (anadromous)	304, 140, 100
Commercial species (marine)	6, 511, 367, 000
Miscellaneous species	25, 707, 300
Total	7, 570, 482, 300

While the above-mentioned increases were achieved partly through more intensive and efficient utilization of existing facilities, several new stations were placed in production. A limited distribution of trout and bass was obtained at the Crawford (Nebr.) substation. The new Valdosta (Ga.) and Fort Worth (Tex.) substations furnished miscellaneous warm-water fishes for distribution. During the year the substation located at Creede, Colo., was constructed and a stock of trout eggs secured for incubation, in addition to the operation of several field egg collecting stations using this point as a base.

During the fiscal year a steel distribution car with a capacity of 300 pails was completed by the builders.

The development of a new pond-cultural substation at Tishomingo, Okla., was initiated but owing to the destruction of a temporary dam by a flood no fish-cultural work could be carried on. The work of developing the bureau's fish-cultural plant in the Yellowstone Park has continued, with the completion of the hatchery building and living quarters.

PROPAGATION OF COMMERCIAL SPECIES

Marine species of the Atlantic coast.—The production of these stations accounts for the greater portion of the numerical output of the entire fish-cultural service. Increases were recorded over the previous year's production of winter flounder, while the cod and haddock figures are slightly below those of 1929. The distribution of 15,500,000 mackerel fry represents an expansion of work which has previously been carried on in a small way at the Woods Hole (Mass.) station. In connection with the work with all of the marine species it was possible to incubate the greater portion of the eggs, planting the fish in the fry stage and reducing the plants of eyed eggs.

Pacific salmon.—As a whole the output of the commercial species of Pacific salmon was materially below that for 1929. The only forms showing increased distribution were the humpback and steelhead salmons. In the consideration of these activities it should be borne in mind that there is a certain periodicity in the runs of Pacific salmon which accounts for marked fluctuations in the hatchery operations from year to year without signifying any particular decrease in the stock of fish. For example, 1930 was a "pink salmon" year in Puget Sound, increasing the distribution of humpback salmon or pink salmon from 1,852,000 in 1929 to 6,302,000 in 1930.

Anadromous species of the Atlantic coast.—In contrast with the very successful 1929 season with shad at the new Fort Humphreys (Va.) station, the 1930 output was virtually a total failure. While there appears to have been a considerably reduced run of shad in the Potomac River, water conditions arising from prolonged dry weather apparently affected the normal spawning habit, so that practically no eggs were obtainable from the available run, which in good years has furnished from 50,000,000 to 70,000,000 eggs. The Fort Humphreys station had a normal season in the propagation of yellow perch. No striped-bass eggs were secured from the cooperative work with this species in North Carolina, probably for the same reason which affected the shad activities. The Craig Brook (Me.) station conducted the propagation of Atlantic salmon along the same lines as in previous years, although a larger percentage of the eggs was assigned to the Maine State hatcheries.

Commercial species of interior waters.—The important fishes included in this group were distributed in numbers showing a material increase over that of the previous year. Despite the fact that the bureau's Cape Vincent (N. Y.) and Put in Bay (Ohio) stations were able to secure whitefish eggs only in greatly reduced numbers, the aggregate production of whitefish for the entire group was over 50,000,000 in excess of that in 1929. The increase was almost entirely derived from the Michigan stations. An output of over 31,000,000 lake trout likewise indicates an increase over the previous year. The Michigan stations also contributed the bulk of this increase, the activities at the Duluth (Minn.) station having been sharply curtailed by a period of stormy weather at the height of the spawning season. The cisco or lake herring showed a very noticeable decline from the 1929 output. While the propagation of pike perch on Lake Champlain was conducted under weather conditions which materially reduced the output, the total production of this form for the entire group of stations was practically doubled. The Put in Bay station enjoyed a particularly successful year with this species. Average success attended the propagation of buffalofish and carp.

GAME FISHES

In reporting its game-fish distribution the bureau includes in this category only the trouts, landlocked salmon, and the warm-water pondfishes, comprising the basses, sunfish, crappie, catfish, pike, pickerel, etc. It is true that the pike perch, the lake trout, and the steelhead salmon are equally sought as game fish in many sections of the country. Inclusion of these varieties in the list of game species would consequently double or treble the output of this class. It is among the game fish hatcheries that the greatest expansion of facilities has occurred, and this expansion is reflected in an increased output of all forms excepting the black-spotted trout, smallmouth black bass, and the grayling.

In developing its program to become independent of all outside sources of egg supply the bureau has established several new collecting stations for eggs of wild trout in the Western States. The Meadow Creek (Mont.) auxiliary of the Bozeman (Mont.) station again eclipsed previous records with the Loch Leven trout, securing over 19,000,000. All station brood stocks of trout have been increased in number and the substation for the production of brook-trout eggs, located at York Pond, N. H., virtually doubled its output of the previous year. Of the total distribution of the game varieties not more than 6,500,000 were distributed in the fry stage, the remainder comprising egg shipments or fingerling fish ranging up to legal size.

In spite of the fact that the cooperative nurseries created a new demand for close to 4,000,000 trout eggs and fry, the bureau has been able to keep practically up to date with the applications for trout. In many instances it has been possible to furnish greatly increased numbers of fish on the usual applications from territories adjacent to the hatcheries. In most cases average success has been attained in the propagation of warm-water varieties in the Southern States. The Fairport (Iowa) station provided a large number of bass for distribution as a by-product of its experimental work. The increased output for the previous year at the Orangeburg (S. C.) station has been maintained. The necessity of transporting rescued fish from the Mississippi River into Montana, Wyoming, South Dakota, and North Dakota was obviated by a splendid output from the Miles City (Mont.) substation, operated in conjunction with the State of Montana.

RESCUE OPERATIONS

After the inactivity of the previous year in the Mississippi River rescue field, natural conditions during the fall of 1929 were such as to permit of extensive operations and over 160,000,000 fish were handled. As usual, shipments on applications to other waters amounted to less than 1 per cent of the total number of fish handled.

COOPERATIVE ACTIVITIES

Wherever the bureau's activities have contact with those of other Federal bureaus or departments, mutually helpful relationships have been established. The Forest Service has furnished a detailed survey showing the requirements for restocking waters in all the principal national-forest areas as the result of conferences looking toward the development of a program for meeting these requirements. The National Park Service has worked with the bureau in closer harmony in connection with the creation of new hatcheries and rearing facilities in both Yellowstone and Glacier Parks. A bureau employee has been placed in full charge of all fish-cultural work in the parks and has been detailed to make surveys of all the important national-park areas for the purpose of working out a coherent stocking policy.

In view of the expansion of fish-cultural work in most of the States there has been a closer liaison between those agencies and the bureau. The propagation of commercial species in Michigan was particularly successful and the whole-hearted cooperation afforded by the State department of conservation contributed largely to these results. The State of Virginia is embarking upon an ambitious fish-cultural program and the bureau has been able to assist in various ways. The construction of an extensive bass-cultural establishment by the State of Arkansas has continued at a rapid rate under the direction of the bureau's superintendent at Mammoth Spring, Ark.

The work of restocking with both game and commercial species has been materially furthered by the harmonious relationships maintained with the States of Washington, Oregon, Wyoming, Minnesota, North Carolina, South Carolina, Maine, and others. With the cooperation of the Indian Service and the State of Nevada the bureau took over the fish-cultural work in connection with the propagation of black-spotted trout at Pyramid Lake. An employee of the bureau was detailed to participate in a survey of the inland hatcheries of the State of Ohio. Additional requests for assistance from a number of other States could not be fully met due to lack of facilities.

The cooperative nursery program whereby sportsmen's associations operating hatcheries or nursery ponds receive fish from the bureau's hatcheries for rearing to larger size has been standardized and constitutes a routine activity. During the fiscal year a few of the older nurseries discontinued operations for various reasons and additional ones were taken on, so that the total of 123 now conducted represents an increase of approximately 10 over the previous year. These organizations were furnished a total of 3,827,700 fish and eggs, largely of the trout species. In view of this heavy demand upon the bureau's trout production it has been necessary to exercise greater care in establishing new nurseries and to require that natural facilities be proper and adequate for the purpose. This has necessitated refusal to cooperate in some instances and termination of the cooperative arrangement already existing in others. Effort has been made to augment the number of bass nurseries and to extend the field of these operations into States and sections previously not touched to overcome the present "spotty" distribution in a few States.

In a number of States where the bureau conducts no cooperative nurseries the States are carrying on this work very successfully and there is little or no demand for the bureau's participation. Two of the establishments in New York and Pennsylvania are complete hatchery units incubating eggs and carrying on all the functions of a regular hatchery, with an employee of the bureau in charge.

It is believed that while the assignment of fish to individual nurseries may be decreased and the establishment of new units may fail to keep pace with the rate set during the earlier years, the output of large-sized fish will be materially increased by the standardization of procedure.

VESSEL NOTES

The *Albatross II* continued her scientific research work, with headquarters at Woods Hole, Mass. During the year the vessel was engaged in operations between Cape Ann, Mass., and Cape Hatteras, N. C., with the exception of one cruise between the continental shelf and Bermuda, which was discontinued on account of pump trouble developing. Oceanographic stations numbering 273 were made between Cape Ann and Cape Hatteras, varying in distance from a few miles to 180 miles offshore. At convenient times between cruises throughout the year the vessel underwent various repairs at the Boston Navy Yard. The vessel cruised 13,017 miles.

The steamer *Shearwater* was engaged in fish-cultural work at the Put in Bay (Ohio) station from November 1 to December 15 and from March 1 to June 1. In addition to this regular work she was engaged in fishery investigations on Lake Erie.

The steamer *Phalarope* was employed as usual as a tender at the Woods Hole biological station, except for a period of a few weeks in the spring when she was at the Fort Humphreys station on the Potomac, in connection with shad investigations.

The *Gannet*, *Plover*, and *Canvasback*, three boats which have been in the service of the bureau for approximately 25 years, have been condemned and will be disposed of. The *Gannet*, which was used at the Boothbay Harbor (Me.) station, is being replaced by a new vessel named the *Pelican*. This vessel is being constructed at Newport News, Va., and will proceed to the Boothbay Harbor station for duty. This new vessel is 78 feet in length, 10 feet 3 inches in depth, and 18 feet in breadth, with draft 5 feet. She is equipped with a 150 horsepower full Diesel, direct reversible engine.

Sixteen vessels of the Alaska service cruised more than 116,000 nautical miles in the fiscal year 1930. Of these, the *Crane* covered about 14,000 miles, the *Brant* 13,000 miles, and the *Teal* about 11,000 miles.

A new power vessel, *Penguin*, designed especially to serve as tender for the Pribilof Islands, was built at Seattle, Wash., and sailed on its initial voyage to the islands early in May. The *Penguin* is 130 feet in length and 27 feet in breadth and is of very sturdy construction to withstand the severe weather and ice conditions encountered at times in Bering Sea. Power is furnished by a 400-horsepower full Diesel engine. The *Eider*, formerly tender for the Pribilofs, was transferred to fisheries patrol work in the spring of 1930 and assigned to the Kodiak district.

Throughout the 1929 season the *Auklet*, *Murre*, *Petrel*, and *Widgeon* patrolled the fishing grounds of southeastern Alaska. Other vessels participated in the patrol of that district in the fall after their return from duty to the westward, as follows: *Crane*, which had been stationed in the Alaska Peninsula area and had also been used to transfer seasonal employees to and from Bristol Bay; *Teal*, which had maintained the patrol on Cook Inlet; *Scoter*, engaged on Bristol Bay; and *Kittiwake* employed in the Seward-Katalla district. The *Blue Wing* and *Red Wing* were used at Kodiak and Afognak Islands; the *Merganser* in the Ikatan-Shumagin district; the *Ibis*, at Chignik; and the *Coot* on the Yukon River. The *Brant* was engaged in general supervisory work and made one cruise westward as far as Unalaska.

In addition to work in connection with the conservation of the fisheries in Alaska, the *Brant* was engaged in a patrol of waters off Neah Bay, Wash., during the spring migration of the fur-seal herd, and the *Petrel* performed similar duty in the vicinity of Sitka, Alaska.

After the close of fishery activities in the fall, the *Brant*, *Crane*, *Teal*, *Eider*, *Kittiwake*, and *Scoter* sailed for Seattle, where they were given the necessary overhauling, and repairs were made in preparation for the next season's work.

APPROPRIATIONS

Appropriations for the bureau for the fiscal year aggregated $2,218,550, as follows:

Salaries	$823, 300
Miscellaneous expenses:	
Administration	4, 400
Propagation of food fishes	524, 000
Maintenance of vessels	152, 000
Inquiry respecting food fishes	108, 000
Fishery industries	53, 750
Protecting sponge fisheries	3, 100
Protecting seal and salmon fisheries of Alaska	370, 000
Upper Mississippi wild life and fish refuge	25, 000
For improvements at the La Crosse (Wis.) station	10, 000
Power vessel for Alaska fisheries	145, 000
	2, 218, 550

Very truly yours,

HENRY O'MALLEY,
Commissioner of Fisheries.

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REPORT OF THE INTERNATIONAL FISHERIES COMMISSION APPOINTED UNDER THE NORTHERN PACIFIC HALIBUT TREATY [1]

By JOHN PEASE BABCOCK, *Chairman, and* WM. A. FOUND, MILLER FREEMAN, and HENRY O'MALLEY, *Commissioners*

The treaty between Canada and the United States for the preservation of the halibut fishery of the northern Pacific Ocean, including Bering Sea, was ratified on October 21, 1924. It is remarkable from the double standpoint that it is the first treaty entered into by Canada as a nation and that it is the first effective one anywhere having for its object the conservation of a threatened high-seas fishery. It, therefore, serves as a precedent for international cooperative control of sea fisheries, where such is necessary. This forms an important additional reason why success should be achieved under it.

The treaty provides an entire cessation of halibut fishing for three months each year. This was regarded, at the time it was entered into, as an essential minimum of protection. It also provided for the appointment of an International Fisheries Commission, the duties of which are to make recommendations regarding the need for modification of the close season, to make a thorough investigation into the life history of the Pacific halibut, and to make recommendations as to the regulation of the fishery that may be deemed desirable for its preservation and development. The specific provisions of the convention dealing with these phases follow:

> The nationals and inhabitants and the fishing vessels and boats of the Dominion of Canada and of the United States, respectively, are hereby prohibited from fishing for halibut (*Hippoglossus*) both in the territorial waters and in the high seas off the western coast of the Dominion of Canada and of the United States, including Bering Sea, from the 16th day of November next after the date of the exchange of ratifications of this Convention, to the 15th day of the following February, both days inclusive, and within the same period yearly thereafter, provided that upon the recommendation of the International Fisheries Commission hereinafter described, this close season may be modified or suspended at any time after the expiration of three such seasons, by special agreement concluded and duly ratified by the High Contracting Parties.
>
> The High Contracting Parties agree to appoint within two months after the exchange of ratifications of this convention, a commission to be known as the International Fisheries Commission, consisting of four members, two to be appointed by each party. This Commission shall continue to exist so long as this Convention shall remain in force. Each party shall pay the salaries and expenses of its own members, and joint expenses incurred by the Commission shall be paid by the two High Contracting Parties in equal moieties.

[1] Appendix I to the Report of the U. S. Commissioner of Fisheries for 1930. B. F. Doc. 1073.

The Commission shall make a thorough investigation into the life-history of the Pacific halibut, and such investigation shall be undertaken as soon as practicable. The Commission shall report the results of its investigation to the two Governments and shall make recommendations as to the regulation of the halibut fishery of the North Pacific Ocean, including the Bering Sea, which may seem desirable for its preservation and development.

The undersigned, having been appointed commissioners under the treaty by their respective Governments, undertook their duties without delay. At the outset they decided to employ a competent man as director of investigations, in which capacity the services of W. F. Thompson were secured. He not only brought to the work the needed training and ability, but the experience and knowledge that resulted from three seasons' investigations in the Pacific halibut fishery, which he had undertaken some years previously on behalf of the provincial government of British Columbia. A competent staff of young, energetic scientists to assist him was also employed. The commission further arranged for the appointment of an honorary scientific council, with which not only the commission but the director of investigations could consult, and to which has been submitted the plans of investigations to be undertaken from time to time. This council consists of two representatives from each country.

Prof. John N. Cobb, dean of the College of Fisheries of the University of Washington, Seattle.

Mr. N. B. Scofield, head of the Department of Commercial Fisheries of the Fish and Game Commission of California.

Dr. C. McLean Fraser, professor of zoology in the University of British Columbia and formerly director of the Marine Biological Station at Nanaimo, B. C.

Dr. W. A. Clemens, present director of the aforesaid station.

The director and staff have from time to time presented reports on the progress of the investigation and on their findings to the commission and to the scientific council. These findings are used in the formulation of the present recommendations. The scientific results are, however, not inserted in this report but will be published later in more detailed form than is practicable here.

The task with which the commission found itself to be charged is one of great magnitude and difficulty. The fishery covers a coast line of about 1,800 miles in length. The halibut can only be studied at sea and under difficult conditions. Hence, it has not been possible in the three years during which the commission has been at work to cover the whole field exhaustively. What has been accomplished has, however, been done with care, and the information obtained is sufficient to satisfy the commission as to the necessity of certain main lines of action if the fishery is to be preserved.

Though the investigation has been highly scientific in character, the commission determined at the outset that it would be carried out along practical lines with close adherence to facts and avoidance of unsupported theory. Its aim has been to establish beyond doubt the actual condition of the fishery at present and the history of its trend to that condition. It has sought to define the remedial measures that should be adopted to save the fishery and to build it up, as well as the conditions that would have to be met in applying such measures.

Statistics have formed an indispensable part of the facts gathered. They have included not only complete records of landings but of operations at sea. Through the splendid cooperation of the fishing vessel captains the commission has secured extensive records of the individual catches, from which the yield per unit of fishing effort, the "skate," has been ascertained for each section of the coast. These cover every season and are for years as far back as 1906.

Even more important have been the biological studies. These have included the rates of growth according to locality, the migrations, the "races" existent, and the spawning habits. Material has been collected by the staff, not merely from voyages on fishing vessels but through the operations of vessels chartered for the purpose. Thousands of halibut have been caught and released with numbered tags attached and have been recovered from fishermen through rewards offered. From the records thus furnished it has been possible to determine the migrations of the halibut. Extensive studies of the physical characteristics and the growth of the different "races" have confirmed such findings. The drift of the eggs and larvæ in the open ocean have been studied by means of fine-meshed silk nets and by observation of the currents. The results of these biological studies, in conjunction with those from the statistics, form the basis for the conclusions reached in this report.

IMPORTANCE OF FISHERY

Fisheries for halibut are prosecuted in the North Pacific and the North Atlantic Oceans, and yield about 90,000,000 pounds annually. The Pacific halibut fishery, which is covered by the terms of this convention, is the greatest in the world. The annual catch exceeds 50,000,000 pounds, which represents about 60 per cent of the world's catch. Of the remainder about 30,000,000 are credited to European countries and 6,000,000 to the Atlantic coast of this continent. The value of the Pacific halibut catch to the fishermen is about $7,000,000 annually, and it is consequently one of the most important fisheries in North American waters. The Pacific halibut is, therefore, one of the most important species of food fishes indigenous to the waters of the North American continent. The halibut-fishery banks of the eastern Pacific are shown in Figures 1 to 3. The division into areas shown thereon is for statistical purposes and should not be confused with those referred to in the commission's recommendations, which will be submitted later on.

CONDITION OF FISHERY

The Pacific halibut fishery originated soon after the first railway communication was established between the two coasts of the United States. It is, therefore, comparatively young. It had its inception in 1888 near Cape Flattery, at the entrance to Juan de Fuca Strait. The fishery expanded rapidly, and by 1910 it had extended to grounds off Cape Ommaney, Baranof Island, 600 miles to the north. Subsequent expansion has extended the fishery until it now covers about 1,800 miles of coast. Formerly as many fish were taken from the 600-mile stretch as are now procured from the entire area of 1,800 miles. The banks on the eastern side of the Gulf of Alaska, which yield spawning fish, were first exploited in 1913. In 1926 the larger boats made by far the greater part of their catches in the vicinity of Kodiak Island, on the western side of the Gulf of Alaska, about 1,200 miles beyond the original fishery. The catch on the older grounds south of Cape Ommaney has decreased from a total in excess of 50,000,000 pounds in 1910 to about 21,000,000 in 1926, and much greater effort was exerted in making the catch in the latter year. It is evident that the present level of production has been maintained by extending fishing operations to new areas, as the catch on the older grounds decreased and by increasing the intensity of the fishing effort.

The amount of gear now used on the older banks is about two and one-half times the quantity formerly used, yet the present catch is only about 40 per cent of the former yield from these grounds. Under the stress of this great intensification of fishing effort the abundance of fish on the older banks has fallen enormously, to 16 per cent of the abundance in 1906. Where in 1906 the catch per set of a unit of fishing gear was nearly 300 pounds, in 1926 it was below 50 pounds. Expressed in another way, it required six units of gear to catch as many fish as one unit caught in 1906. The decline has gone on at an even rate and shows no tendency to slacken. Accompanying this fall in abundance there has been a decrease in the average size of the fish landed, and a great increase in the percentage of undersized fish. For example, between 1919 and 1926 the percentage of undersized fish from the older banks increased from 20 to 30 per cent.

The more recently exploited banks to the westward show the same trend, the catch having fallen from 160 pounds per unit of gear in 1923 to 100 pounds in 1926 and was still lower in 1927, while at the same time there was an increase in the number of fish under 11¾ pounds.

The rapidity of decline is regarded as especially serious because of the very slow rate of growth of the halibut, an adult being from 12 to 25 years, or over, in age. Hence the present decline has taken place within the life span of one halibut of ordinarily large size. As nearly all the fish that are being caught now were spawned 8 or 10 years ago, the abundance of the younger fish, which will annually be available for capture in the next 10 years, has already been established. If these are greatly reduced in numbers, and the intensity of the fishery is maintained, the outlook for a future stock of spawning fish sufficient to maintain the supply presents a hopeless picture. In fact, the commission's investigations indicate that relatively few mature halibut are now found on the older banks.

These illustrations demonstrate beyond a doubt that the fishery is in a very serious condition and that the banks can not stand the intensity of fishing to which they are subjected. The commission is fully convinced that the conditions are so serious that no delay should be permitted in the adoption of additional conservation measures. In the light of the investigations made such action is essential to the maintenance of the fishery.

RECOMMENDATIONS

The commission recommends certain additional measures of conservation, which are here summarized and are dealt with in detail in pages following. It is recommended that power be given proper governmental authorities:

1. (*a*) To establish areas, within each of which, if deemed necessary for the preservation of the fishery there, the total catch of halibut may be reduced by a predetermined percentage annually, commencing not less than one year after the putting into force of this recommendation, until the fishery therein shall reach a state of stability of yield.

(*b*) To determine upon the amount of this percentage reduction, and to revise the same from time to time as may be found necessary, the intent being to restrain any increase in the amount of fishing within such area.

2. To close permanently to all fishing the two areas herewith defined and known to be populated by small immature halibut, and to close such other grounds as may be found by the commission to be populated by a similar class of fish.

3. To prevent the use of any fishing gear deemed unduly destructive.

4. To extend the present close season by two weeks at its beginning, making the closure for all fishing in all areas from November 1 to February 15, both dates inclusive, and to facilitate future alterations in the length of close season.

5. To license all vessels fishing for halibut in treaty waters under such terms as are necessary for the purpose of the treaty, including statistical returns, and for clearance to regulated waters.

1. ESTABLISHMENT OF AREAS AND LIMITATION OF CATCH THEREIN

The commission is unable, after careful scrutiny, to recognize in the close season as now constituted any contribution to the preservation of the halibut fishery. From its study of the effects of the closure and of the fishery in general it has reached the conclusion that to render any regulations beneficial from this aspect they must be framed so as to distribute their effects according to the needs of the different banks or areas, and that on each of the badly depleted areas the amount of fish taken must be reduced. The present measure is not thus framed.

Its investigations have shown that the banks along the Pacific coast are inhabited by stocks of halibut which are largely independent. Extensive tagging experiments have been carried on, with careful examination of physical characteristics and rates of growth. The fish below spawning size have thus been shown to be well differentiated according to bank and to move but little in comparison with the great extent of the grounds. The fish of mature size are perhaps less limited in range but are still sufficiently localized to render generally ineffective regulations of local application. In accord with these findings, and in checking them, the various banks have been found to be very unevenly depleted. A relative abundance exists on the more distant banks, with a marked degree of depletion on the nearer, the degree of depletion being dependent upon the distance of the banks from the markets. The proportion of spawners is high on the more distant banks but almost nonexistent on the near-by banks. There appears to be such active interchange as would render regulations applied to one bank effective on all.

It has, therefore, become of paramount importance to discover how far the effects of regulation are localized, for each area must bear the burden of its own regeneration. The commission has, therefore, carefully and laboriously collected statistics regarding the effect of the close season on the several main areas of the fishery. The closure being from November 16 to the following February 15, it has affected directly the fisheries at that time taking place. These were along the eastern side of the Gulf of Alaska, between Cape St. Elias and Cape Spencer. Here there has been prevented a very considerable fall, winter, and spring catch of mature fish. In contrast to this, the fishery on the older more depleted banks south of Dixon Entrance has for years been a summer fishery, and, accordingly, the amount of the catch eliminated has been very small. At the time of adoption of the present treaty the newer, less depleted banks to the farther west of the Gulf of Alaska did not have a fishery of any magnitude, but since then a very considerable summer or open-season fishery has been developed. The close season has mainly affected, therefore, one area—that on the eastern side of the Gulf of Alaska.

Examination of catches on these affected grounds has shown that the fish protected were largely fish collected there for spawning, which is well known. It is, therefore, evident from these facts that the close season has been operative almost entirely upon the fish of a given region and upon a single category of these fish, facts that should be considered in connection with the independence of the various stocks of halibut.

The commission finds that the fish thus protected by the closure were exposed to fishing that was increased in intensity during the open season, and, consequently, the abundance on the banks has undergone a further decline due to progressive depletion.

Tagging experiments with the spawning fish on the banks thus most affected—those on the eastern side of the Gulf of Alaska—showed that a considerable migration occurred to the westward as far as Portlock Bank, where many of the tags were recovered. There, fishing during the open season has increased enormously during the three years that have elapsed since the close season has been in effect, sufficient to more than offset the decline in the winter fishery on the other banks. But this increase has not been due to any increase in numbers of fish, for the intensification of the Portlock fishery has led to a rapid fall in yield per unit of gear fished, from 160 to 100 pounds per "skate," and these western banks are not "holding up." If further proof were required that this enormous increase of the fishery on Portlock is not due to the presence of more fish there, it will be remembered that halibut are on the average considerably more than 5 years of age when they first come into the commercial size, and that the great increase in catch was, therefore, from the preexisting stock.

The same increase in the open season total catch is obvious on the banks referred to as most affected. This increase, too, was due to the more intensive fishing and not to an increase in the abundance of fish. Had there been an increase in abundance there would have inevitably been an instant increase in fishing sufficient to destroy the increase in abundance before it progressed far—it could not escape the notice of the fleet.

On the older banks, as has been said, the effect of the closure was very small, and during each month of the open season there was a decrease in the total taken, due to the progressing depletion of the banks. Yet this decline did not suffice to balance the increase on the other banks.

In accord with this, the absence of marked effects beneficial to the perpetuation of the fishery is shown by the fact that there has been no reduction in the total annual catch. On the contrary, there has been an increase, as is shown by the following statistics of landings for the 5-year average preceding the close season and for the 4 years the close season has been operative:

	Pounds
Five years' average, 1919 to 1923	51, 595, 000
1924	57, 691, 000
1925	53, 170, 000
1926	56, 278, 000
1927	56, 899, 000

The close season, therefore, has merely shortened the period within which the catch has been taken.

The reasons for this increased intensity of fishing, which has more than balanced the effects of the close season, are not far to seek. The economic advantages of the closure are sufficiently great to explain the lack of decline in total catch. The season of the year during which fishing is prevented was the most expensive, because of the bad weather, the consequent loss of gear and of time, and the severe effect on the morale of the men. With the elimination of the three winter months the work during the remainder of the year has become more efficient, and the losses and delays inherent in fishing operations have been greatly reduced. Moreover, the vessel owners at present spend part of the close season in overhauling their gear and boats. A certain part of it is used en route to and from the fishing areas. The market for frozen fish is steadier, giving better prices for frozen fish according to general opinion. Furthermore, the grade of fish taken during the summer months is said to be superior to that formerly taken during the winter. The closure thus being of benefit from an economic standpoint, it follows that as long as the fishery continues to pay well, as it has in the past, there is no limit to the expansion it will undergo beyond the satisfaction of the demand. The close season could not be expected to restrict without adverse economic effects.

It is, moreover, true that in the past there has been a general and rapid increase in intensity of fishing sufficient to counterbalance the effect of the closure. Thus, on the older banks the amount of gear fished is about two and one-half times that employed in 1910. This great and rapid increase in intensity has gone on unchecked during the nine most important months of the year. So great has it been that it has sufficed to maintain the total catch despite a fall in returns per unit of gear fished and despite the fact that the new grounds exploited have yielded at their maximum but a third the abundance of fish found originally on the older southern grounds. Some measure of the effect of the closure in relation to this increased intensity can be gained by comparing the amount of catch formerly taken on the grounds along the eastern side of the Gulf of Alaska, with the effect of the fall in abundance from year to year. It is estimated that not more than 6,000,000 or 7,000,000 pounds came from these grounds before the closure, or about 10 or 12 per cent of the total for the coast. The loss of this could not exceed that annually lost through a failing supply, since on the older grounds the fall in abundance was approximately 10 per cent yearly, and on the newer grounds even greater.

It is evident that the close season has met a complexity of conditions which destroy its uniformity of operation and that in its application to one subordinate portion of the fishery it has left abundant opportunity for all supposed benefits to be eliminated. A stream can not be controlled by throwing a dam half across its course. The result is nothing more than an increased rate of flow in the other half.

The commission has been unable to devise any general measure for the whole fishery, which would properly meet the needs of the various areas.

Artificial propagation of the halibut is, for technical and scientific reasons, impracticable. The numbers of young that could be thus produced would be a minute part of those hatched under natural conditions. Their culture would be expensive, and the young fish could not be kept long after hatching. Hence, it is evident that the natural supply is overwhelmingly the most important and that it must be cared for. The only adequate manner of meeting the present situation is to preserve in each area a sufficient number of young to produce spawning adults and to leave enough of the latter to produce an adequate amount of spawn under natural conditions.

It becomes evident, upon the first study of the halibut fishery, that regulations designed to produce and protect such a spawning reserve must be adapted to very different conditions in the various areas. The state of depletion varies from area to area, and the need for regulation varies accordingly. Certain of the banks have been resorted to for many years, while others are undergoing their first exploitation. In accord therewith the yield and abundance of fish varies. Moreover, the initial returns from any bank reflect the abundance thereon under natural conditions, and the newer, more westerly banks are much less productive naturally than the older southern banks—about a third, in fact. In agreement with the state of depletion, the percentage of mature fish varies from a very small one on the southern banks to a high one on the western, and there is, therefore, a fishery for spawning-age fish on some banks and a fishery for immature fish on others. The fish on the banks vary not merely in their natural abundance but in their rates of growth and physical characteristics. Thus, the trade terms applied to fish according to size have a very different meaning and do not indicate their age or their need of protection. The seasons of the fishery vary, also, in accord with the biology of the fish and the geographic location of each bank. In agreement with all this, the same complexity is found reflected in the fleet, the fishery on various banks being carried on by different types of fishing vessels with different seagoing ability, different methods of fishing to some extent, and different landing ports. No uniform protection of a single class of fish (such as the spawners), no close season, no size limit, or limit on gear, will be found to apply equally and efficiently.

The commission, therefore, finds itself forced by the aforesaid conditions to a consideration of the treatment of each individual area according to its needs. In thus acting it sees two alternatives.

One of these is to follow the method used in adopting the present close season, and on the basis of an exact and intimate knowledge of the fishery in each area to close such seasons, protect such classes of fish, or prohibit such gear as will reduce the amount of fish caught to the amount which the species is able to replace. This alternative has the same faults as has the present close season. It is necessary to look forward to a compensating intensity of the fishery on those classes not protected or upon all classes during the open season. The degree of this reaction of the fishery is an economic matter, for as long as the fishery pays, there is no doubt but that it will increase gear and vessels to supply the demand. The restriction can not be effective unless it so raises the expense of the fishery, the costs of operation, as to prevent this increase. In that sense the restrictions become, if successful, economic handicaps adjusted to limit to the required extent the fleet and the amount of fish removed. The results of the present closure, the complicated conditions to be met, the extensive and arbitrary powers which would be necessary to meet unforeseen changes in the economic world, and the wide knowledge necessary discourage the adoption of this alternative.

The commission feels that the effect of regulations so varied would be difficult to forecast, and that in many cases the results would be harmful rather than good. The manner in which the fishery compensates itself for the protection of a single category of fish, such as spawners or young, has already been referred to in the discussion of the close season and will be discussed further when dealing with the closure of small-fish grounds. The biological conditions underlying the principle of protecting spawning, mature, or young halibut are still unknown, and it is impossible to be certain that the shifting of the strain to any one of these classes rather than another is actually beneficial. Great fisheries exist which make exclusive use of one or the other. Many regulations, particularly those regarding gear, may be handicaps in the development of efficiency or become causes of high cost of operation, which limit the output per man and prevent the sale of the catch at reasonable prices. Failure to dispose of the catch causes a surplus. The existence of the surplus creates a demand for further restriction of the catch per man or per vessel, with still higher costs of operation, so that the evil may be intensified instead of relieved.

The commission, therefore, regards this first alternative as undesirable and ineffective, both from scientific and administrative standpoints. It would be at best, an attempt, by indirect methods, to reduce the amount of fish taken from the bank. The commission regards it as the part of wisdom to proceed directly to a regulation of the amount of fish taken from each area, by closure when such amount reaches a predetermined limit.

The commission is fully aware of the care that must be used in undertaking a task of this character. It has given careful consideration to the determination of the minimum reduction consistent with the perpetuation of the fishery, having in mind the least possible harm to the industry.

There has been, without restrictions, a decrease in the total catch from the older areas. The banks south of Cape Ommaney yielded, in 1910, more than 50,000,000 pounds, whereas at present there are not more than 21,000,000 taken. Since the amount of fishing that produced these totals is and has been too great for the banks in their present state, this decrease must be taken into account, and the restrictions imposed must be sufficient to more than cover this decline or it would be meaningless.

This declining total yield is secured by means of an increasing amount of gear. In other words, the intensity of the fishery has become greater, and a constantly higher proportion of the stock is taken. Six units of gear are set now for the same result that one formerly yielded. This increase in the amount of gear and vessels is not in the best interests of either the fishermen or the halibut, and it is the greatest danger to which the fishery is subjected. The increased proportion of the stock taken lowers the abundance of fish on the banks progressively until a very minimum is produced, not merely for the effort involved but in total. Therefore, if stability of return from the fishery is sought, the intensity of the fishery should not be continually increased.

Without positive restriction, the investment in gear and vessels already existent will face a decline in returns of fish in accord with the decline in yield per set of a standard unit of gear, the "skate." This yield reflects the abundance of halibut on the banks and its changes; and a certain number of sets of such skates should, on the average, take a definite proportion of the total stock on the banks. So that, to maintain the present rate of removal or proportion of the existing supply taken annually, the total catch allowed from a given area must be diminished at a rate at least equal to the rate of this decline in returns of the gear in present use.

But, knowing that the present proportion of the supply captured is too great a strain upon the species, what hope can be held forth that the retention of that rate of removal would bring stability or permanence to the yield? The proportion taken is already in excess of the rate of replacement. We know that with the total yield as it is, this abundance, as measured by the yield per unit of gear, is still declining. Is there any ground for believing that this decline would stop?

Hopefulness lies in the fact that the rate of replacement varies with the condition of the fishery. It is a well recognized biological law that under a state of nature a maximum population brings about a decline in the rate of reproduction until replacement just balances mortality. This is self-evident, since species can not go on increasing indefinitely without overpopulating the world, which none of them do. But where, from one cause or another, the maximum population is not present, the rate of reproduction is much higher than the mortality and up to a certain point becomes increasingly so. This has been observed in many organisms, ranging from man and the various species of birds introduced into America to transplanted species of fish, such as the shad and various insect pests. Among indigenous species this phenomenon must hold true in order that they may recover from disastrous years. Whether this is caused by a greater abundance of food for the fewer individuals or by some other factor, it would seem to be a general rule that the rate of replacement is higher when the species is below its maximum in numbers. Hence, if the decline has not gone too far it is to be expected that in response to steadiness of the mortality rate the numbers of the species will decline only until the thereby increased rate of replacement is sufficient to balance the mortality.

With the data at hand, evidence of this increased productivity in the halibut is available. The abundance has fallen on the grounds south of Cape Ommaney in 16 years to about 25 per cent of its original amount, but the total catch seems to have fallen to about 40 per cent, therefore not as fast. Such a calculation can not, in the nature of things, be exact; yet it errs on the conservative side, as for reasons that can not be detailed here, the fall in abundance may have been greater than this, possibly to such a degree that the present abundance is but 15 per cent of its original amount. In this case the contrast with the decrease in total catch is still more marked. The lower level of abundance seems to have produced in recent years a higher catch in proportion, although not in total figures.

There is, therefore, ground for believing that if the proportion taken does not increase, the halibut fishery on the older banks will ultimately come to a position of stability. This would imply the reduction of the total catch at a rate equal to the fall in abundance of the stock of fish. The latter can best be measured by the returns per set of a standard unit of gear. This indicates that from 1906 to 1926 the fall has been at the rate of 10 per cent a year. Such a reduction in total catch is the minimum that could be considered for the purpose and is equivalent to the use of a fleet and gear the equal of that now employed.

It will be noted that the essential principle of the reduction in total catch is that it shall proceed at a rate at least equal to that of the declining return from a definite amount of fishing. Were this to be accomplished with precision, the reduction in catch would cease immediately with the cessation of the decline in abundance; and with a definite amount of fishing the returns would then be constant. It is the same principle upon which regulation of the salmon fisheries in Alaska and British Columbia is conducted—that a definite proportion of the fish shall be allowed to pass the commercial fisherman.

The adoption of such a procedure must be made with full knowledge that it may not suffice. The thinning out of the population may have already gone so far as to have increased the rate of replacement to its maximum. No further increase may be possible, so that the present degree of intensity of fishing may suffice to continue the decline, or the present drain on the species may exceed anything that even an increased rate of replacement may be able to care for. In such case the only alternative would be to reduce the catch annually at a faster rate. That is for the future to indicate.

On the other hand, it is well recognized by the fishermen that the banks are now but very sparsely populated, and it is more than possible that the maximum rate of replacement was reached long before the thinning out had proceeded as far as it has. In that case a larger population of halibut than now exists on the banks would give a proportionately larger total replacement, and a greater amount would be available for the fishery without harm to the species. Therefore, once the halibut fishery is brought to a stable condition the question will undoubtedly arise as to whether a further step to increase the "breeding stock" may not be advisable. This distinct possibility of increase in total yield would necessitate a temporarily greater restriction than that which is here proposed.

The determination of the amount of the reduction in the total catch from any area must, then, be guided by a study of the amount of fishing in relation to the returns. In making this determination, the discretion of the regulatory powers must be relied upon in drawing conclusions from the statistics obtainable. The latter should, however, be as accurate and comprehensive as is possible. The information now in the hands of the commission is very extensive for recent years but less so for the earlier years. It must serve as a basis for the initial reduction. For the period 1906 to 1926 the rate of fall in abundance has been 10 per cent a year, with minor fluctuations of one to five years in duration, when there may or may not have been a continuous fall. Further reductions should be based on accurate, comprehensive data as to men, boats, and gear used and the returns therefrom, so that the condition of the fishery may be measured in as many ways and as correctly as possible. Upon this information the rate of reduction in total catch should be revised at as frequent intervals as possible.

The frequent revision of this rate of reduction is necessary for several reasons. In case the reduction reflects the changes in the abundance of fish, as shown by the catch of a given amount of gear, unnecessary increases and decreases in fishing operations would be avoided. Furthermore, in case the rate of decline in abundance slackens, the reduction in the catch should be less, so that when the fishery becomes stable in yield, reduction will cease at once.

From present statistics, the initial total catch from which the reduction should be made can only be estimated for the several regions. The information at hand is designed to be representative only, and not comprehensive. It was obtained through voluntary returns and may not give results comparable with those from a more complete legally enforceable system. The commission regards it as necessary that the installation of a complete system of records be made at once, so that the initial amount from which reduction is made shall have been obtained by the same system and under the same conditions as those subsequently determined as limits. For that reason no reduction should be made until complete returns are at hand for a full year.

As has already been said, the reduction made in the total catch should vary with the needs of the various areas. This implies the formation of such areas for administrative purposes. In view of the fact that such control, if adopted, would be applied for the first time in the history of deep-sea fisheries, it is the commission's opinion that they should be large enough to render enforcement easily effective, and that they should correspond to a natural division of the fleet.

For this purpose the first division should be into two main areas—the banks south of Cape Spencer and those north and west thereof. Later, when there has been more experience with the matter, smaller areas may be chosen, if deemed necessary.

2. PERMANENT CLOSURE OF SMALL-FISH GROUNDS
3. PREVENTION OF GEAR DEEMED UNDULY DESTRUCTIVE

In the halibut fishery the sizes vary from 2 or 3 pounds to over 200 pounds. The value of the very small fish, if they are accepted at all, is very low. It is not until a size of 11¾ pounds is reached that full price is obtained.

The small fish are everywhere the young, still rapidly growing, and are not a different race of fish from the medium-sized, first-grade fish. The smallest fish, the so-called "baby chickens," are from 5 to 8 years of age and during that period treble their weights. The next class of fish, the "chickens," are from 8 to 11 years of age, on the average, and within the three years they double their weight. These statements are, of course, approximate only and pertain to halibut from Hecate Strait. On the western banks the ages are greater because of the slower growth. The mortality of these young fish is probably light, since even at their ages they are larger than most of those fishes that are presumably their enemies.

It, therefore, appears economically desirable to protect these small fish until they are of larger size. The gain in weight of the individual would be supplemented by the increased value, pound for pound, so that the economic gain would very probably be considerable. The hearings held by the commission indicate almost universal acceptance of this view, one that the commission indorses.

The commission believes it very evident, however, that if the small fish become more valuable at a later stage of life, and that if the fishery thereby gains from an economic standpoint, the intensity of the fishery will correspondingly increase. It is natural that the profit in a fishery should govern its intensity; and the greater the profit in fishing the larger classes of fish, the more they will be sought after. What would be saved in one part of the fishery would simply be added to another part, and there is no economic reason why that part should not be fished just as closely and to as low a level as before. This being so, it is unlikely that any considerable part of the fish protected by regulation would survive the four or five years necessary to reach spawning size after leaving the "baby chicken" stage. To retain for the fishery the benefits that accrue from the protection of these small fish would involve restraint of the fishery within the area concerned for other grades of fish as well.

Nor can the gain by such protection be in any way a substitute for general restriction of the fishery. Even were there thus permanently withheld from the fishery some small fraction of the total population, there would be serious doubt as to whether it could compare in magnitude with the loss in abundance that is year by year incurred by the general increase in gear used. It would, as was remarked in connection with the closure of the winter season, simply cause a temporary setback that would be offset by an increase in intensity of the fishery.

Furthermore, it is to be considered that protection has to some extent been afforded these smaller sizes in the past by trade usage and agreements with the dealers. The price obtainable for them has always been low. The sentiment against "baby chickens" being landed was, and still is, strong. They have constituted a third grade of fish, which were supposed to be destroyed and not sold. Yet the decline in the halibut fishery has gone on.

The percentage of the smallest size of fish landed is not known, but that of "chickens" is recorded. This should show the trend. There has been, for instance, a more or less steady increase from 20 per cent to 30 per cent of the total landed at Prince Rupert from Hecate Strait in the last seven years. There is little doubt that undersized fish are forming a continually larger share of the catches from the southern banks in general. Legal protection to these small fish may prevent their use in the future to an increasing extent, but it can be preventative only and not constructive. It can not apply to the factors that have caused the damage in the past, unless there are sizes included which have in the past formed acceptable parts of the market landings.

In considering the protection of these small fish, whatever sizes are included as such, their distribution is important. They are found to a greater or less extent in all areas and form a factor in all catches. But the smallest sizes are found in much greater proportion on certain banks commonly called "nurseries." Whether the extent of these banks or the number of small fish thereon has increased is difficult to say, as accurate observations have not yet been completed. Those "nurseries" which have been recognized for many years are on the old more southern banks; but when the western grounds are better known, "nurseries" will doubtlessly be distinguished by fishermen there. At present little can be discovered statistically as to distribution or relative abundance in various areas. Vessels fishing on "nurseries" are reluctant to admit the fact. Catches everywhere are mixed and are rarely made from one area. The fishermen shake off the smaller sizes, frequently in great numbers, so that their catches do not give a fair picture of the proportion of small fish. They reflect, more than anything else, the market demand; but they also reflect the distance of the bank fished, since a catch of low-priced fish is not likely to be brought from a great distance as long as there is any chance for first-grade fish. Hence, although it is possible to say that certain "nurseries" actually exist, it is not possible as yet to give an accurate picture of the distribution of young, nor of what the effect of various restrictive measures on the various areas might be.

There have been three methods of protection for small fish suggested, namely, (1) the imposition of a size limit, (2) the prohibition of the use of small hooks, and (3) the closure of "nurseries" to all fishing.

The use of a minimum size limit would involve a great destruction of undersized fish, much more extensive than is now the case. The investigations of the commission during tagging operations showed that more than 50 per cent of the small fish are seriously injured by hooking even when carefully handled. It is deemed highly probable that when such fish are handled as roughly as is done in commercial fishing, when they are jerked off the hook, only a very small part of the 50 per cent are in good condition for survival. Yet, as previously explained, in all commercial fishing, wherever the lines may be set, it is impossible to avoid the capture of a certain percentage of these small fish, and occasionally a high percentage. If such catches were to be discarded great waste would be entailed.

To a certain extent fishing on "nurseries" or small-fish grounds would be penalized. Yet when prices for fish are good, it is probable that vessels would nevertheless use these grounds, culling extensively, as is now frequently the case. It is, therefore, preferable to act directly in the protection of these "nurseries," as is proposed below.

Another proposed method of protecting small fish is to prohibit the use of smaller-sized hooks (other than the standard No. 6283), which are used with lighter lines. This matter was carefully investigated by the commission in a series of experiments. It was found that the small-hook gear, supposed to catch an undue proportion of small fish, actually did not do so but took no larger nor smaller proportion of small fish than did the standard gear. On the other hand, the small-hook gear was more efficient, catching as much as 60 per cent more fish per unit of gear set, whether large or small fish were considered. But the lighter lines are adapted to fishing in shoaler water, where fishing conditions are easier and where there are now greater quantities of small fish than formerly in proportion to large. In deep water, and for large fish, the amount of breakage was found to be high. The prohibition of this gear, therefore, becomes a possible means of penalizing the present fishery on the older grounds, where the fish are mostly small.

At present the commission has not ascertained the efficient element in the combination, which would have to be covered by a "blanket" prohibition. Heavier, less flexible lines would have to be required on all grounds. Yet it is entirely possible that the efficient element could be adapted for use in deep-water fishing for large fish, and the commission is loath to block the development of efficiency for its own sake. If the shoaler grounds are to be fished at all, and, indeed, if the halibut fishery in general is to be carried on, it would seem the part of reason that it should be done with efficiency and that the amount taken should be limited in a direct fashion, as has already been proposed.

The use of the small-hook gear is, moreover, a relatively recent matter. As with the "nurseries," prohibition of its use is a preventive of future additional ills and not for those which have already injured the fishery. Its prohibition can not suffice in itself to meet all of the existing conditions, the extent of its effect can not easily be foretold, and the great increase of the fishery could proceed unchecked along previous lines. It partakes of the disadvantages of indirect economic restrictions, which must, in the end, be justified by the amount of restriction in total catch they impose, a method regarded undesirable by the commission.

In all the circumstances the commission desires to defer its recommendation as to the use of this gear, but provision should be made to prevent the use of any such gear deemed unduly destructive in the light of future investigation.

The third alternative, the closure of the young-fish grounds or "nurseries," remains to be considered. On these areas the commission, by means of its own fishing operations, has found that the fish are actually the younger classes only. They are populated by very few fish over 11 pounds in weight, the majority being well under 8, and some being as small as 3 pounds. Their age, on the average, is from 5 to 8 years. No mature fish are found among them except as strays.

Closure of these areas would, therefore, be a clear-cut protection of young fish. Unlike a size limit, it would not involve great waste of culled fish, but it would prevent the worst of what now occurs. No hindrance would thereby be placed upon the use of what small fish are taken on the banks in general in the course of ordinary fishing. There would be no penalty upon efficiency of method. The economic benefits to be derived from the increase in weight and value per pound would not be conditioned in any way by economic losses. If the protection of young fish is desirable, then the closure of the nurseries must be.

But the area thus protected is very small in comparison with the extent of the banks as a whole. The some five or six hundred square miles includes but a very small fraction of the general halibut population, or, indeed, of the small fish in general. To that extent their closure could, even if it completely removed these fish from the catch, be but of small effect compared to the general increase in intensity of the fishery. Moreover, what effect is observable must be confined to the general region in which these nurseries are located because of the slow migratory movements. For these reasons, the closure of nurseries being advisable, the principle should be extended to all similar banks in all parts of the grounds as soon as definite information is at hand.

In view of the present condition of our knowledge of marine fisheries, a word of caution in regard to such closures may be added. The maximum productivity of a bank may not be served by permitting overpopulation. Although it would seem unlikely that such would occur, nevertheless the condition of the "nurseries" should be under observation, and too implicit faith in their efficiency should be withheld.

The commission, therefore, while it agrees with the universal sentiment for closure of these grounds, regards the principal justification for closure as economic. The value of such action for the perpetuation of the species must be conditioned upon the control of the remaining fishery and must, at best, be insufficient to stem the course of overfishing in general.

The areas that the commission recommends should now be closed are the so-called "nurseries" about Timbered Islands, Alaska, and Massett, British Columbia. Their description is as follows:

Timbered Islands nursery.—The waters off the coast of Alaska within the following boundaries: From the northwest extremity of Cape Lynch, Heceta Island, southwest (magnetic) 18 miles to a point approximately latitude 55° 42′ 21″ north, longitude 134° 12′ 30″ west; thence southeast (magnetic) 19 miles to a point approximately latitude 55° 24′ north, longitude 134° 3′ 42″ west; thence approximately northeast (magnetic) $8\frac{6}{10}$ miles to the southern extremity of Cape Addington, Noyes Island.

From the northwest extremity of Cape Lynch, Heceta Island, southeast three-fourths south (magnetic) approximately $14\frac{1}{10}$ miles, to a point on Noyes Island in range with the peak shown on chart No. 8150 published by the Coast and Geodetic Survey, said point being approximately in west longitude 132° 39′ 30″.

Massett nursery.—The waters off the north coast of Graham Island within the following boundaries:

From the northwest (magnetic) extremity of Wiah Point, Graham Island, true north 5½ miles to a point approximately latitude 54° 12′ 20″ north, and longitude 132° 19′ 18″ west; thence true east 25 miles to a point approximately latitude 54° 12′ 40″ north and longitude 131° 37′ west; thence magnetic south to a point on Graham Island.

4. THE EXTENSION OF THE PRESENT CLOSE SEASON BY TWO WEEKS, AND THE FACILITATION OF FUTURE ALTERATIONS

Article I of the present treaty provides a yearly close season for all halibut fishing in the waters covered by the treaty from the 16th day of November to the 15th day of February following, both days inclusive. The economic advantages of this closure and the absence of effects beneficial to the perpetuation of the fishery have been already commented upon. It is evident that the close season has merely shortened the period within which the catch has been taken

The commission is satisfied, however, that the adoption of the close season was a wise measure, as it has obvious beneficial economic effects as far as the whole fishery is concerned. It eliminates the most expensive fishing part of the year and one which is also full of hardship. It stabilizes the price of frozen halibut, and this, in turn, has a favorable effect on the demand for such frozen fish. The catches at that time of year are claimed to be of poor quality and frequently so great as to lower the selling price below what is profitable. On account of these conditions all branches of the industry and the commission are unanimous in their support of maintaining the close season.

Indeed, with the exception of the owners of some of the large fishing vessels, who feel that their investment is too great to admit of a longer close season, the industry favors the lengthening of the closure by two weeks at both ends.

The commission is satisfied that lengthening the close season by two weeks at the beginning would not be seriously detrimental to any interest and would be economically beneficial to the industry as a whole. Hence, it recommends that by special agreement of the character provided for in Article I of the treaty the annual close season be lengthened so as to begin on the 1st instead of the 16th of November in each year.

It is entirely conceivable, however, that under other circumstances the present length of the close season would be too great and would lead to serious economic difficulties. Conditions in a fishery are not so stable as to justify reliance upon their indefinite continuation. At the present time prosperity would seem to render the maximum closure possible, but it does not follow that this will be permanently true. There should, therefore, be provided means whereby the length of the close season may be altered more readily than is now the case.

In concluding, the commissioners desire respectfully to urge upon their governments the very serious conditions of this great fishery and the necessity for prompt action to rehabilitate it.

(Signed) JOHN PEASE BABCOCK,
Chairman.

WM. A. FOUND,
MILLER FREEMAN,
HENRY O'MALLEY.

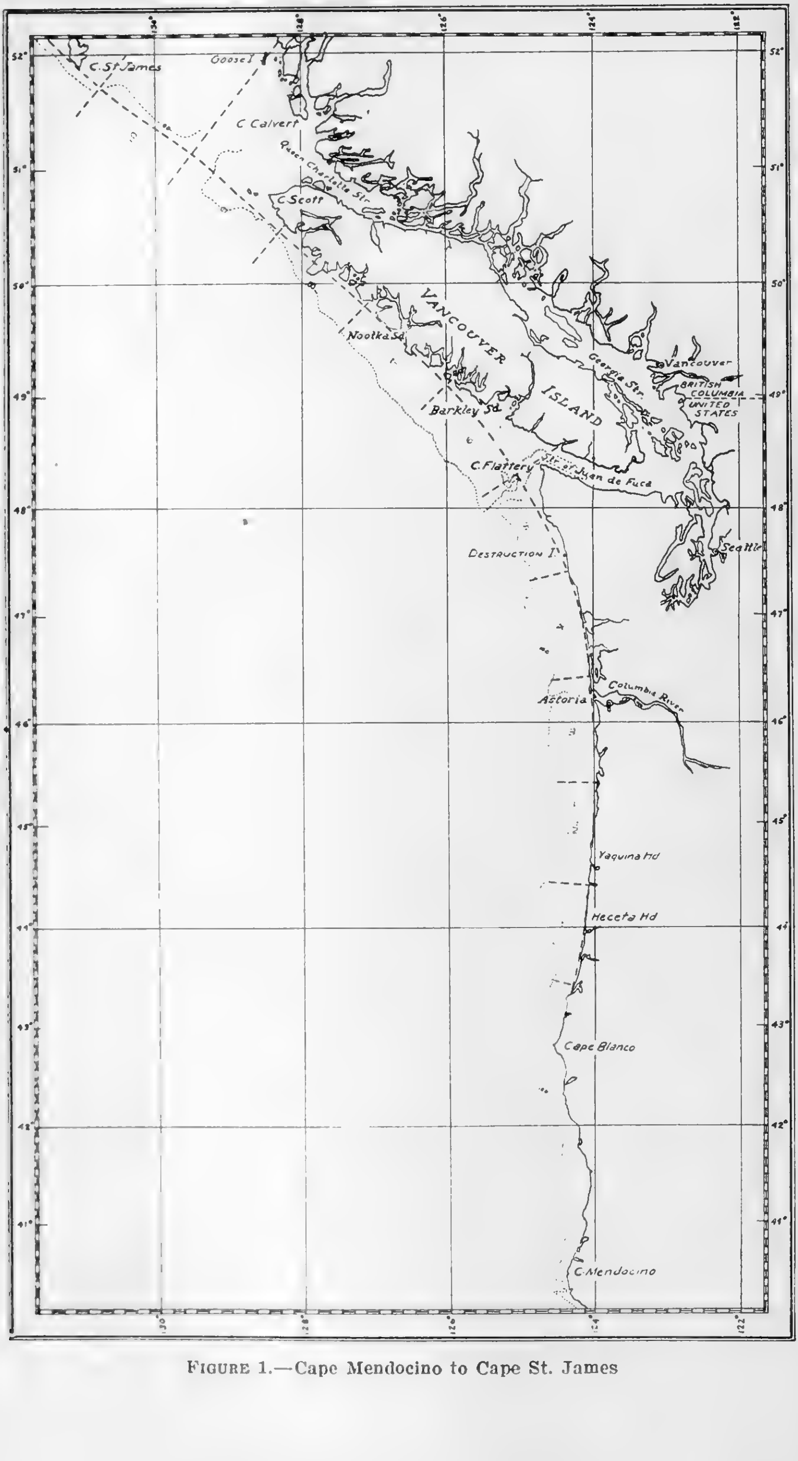

FIGURE 1.—Cape Mendocino to Cape St. James

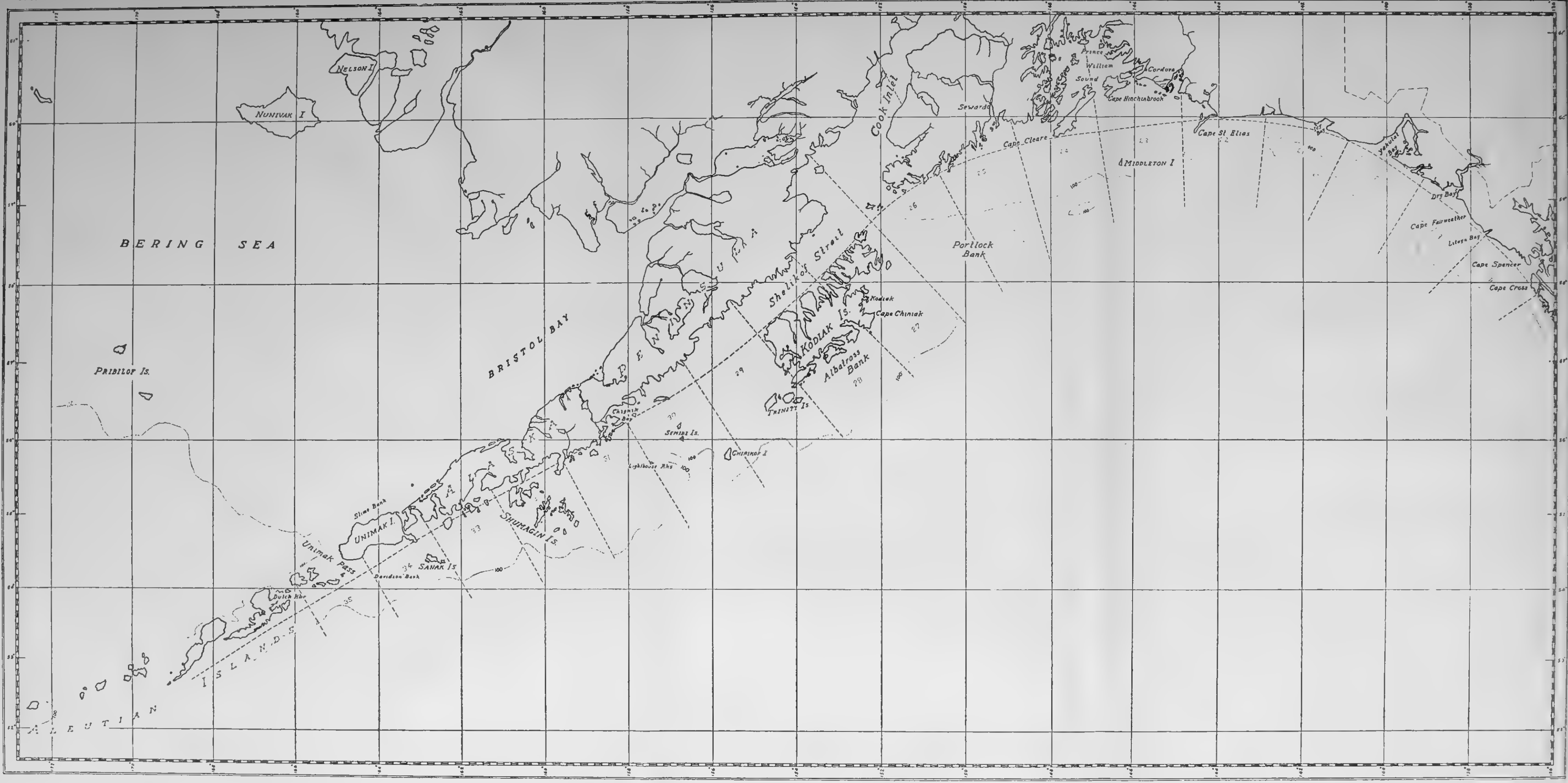

FIGURE 3.—Cape Spencer to the Aleutian Islands

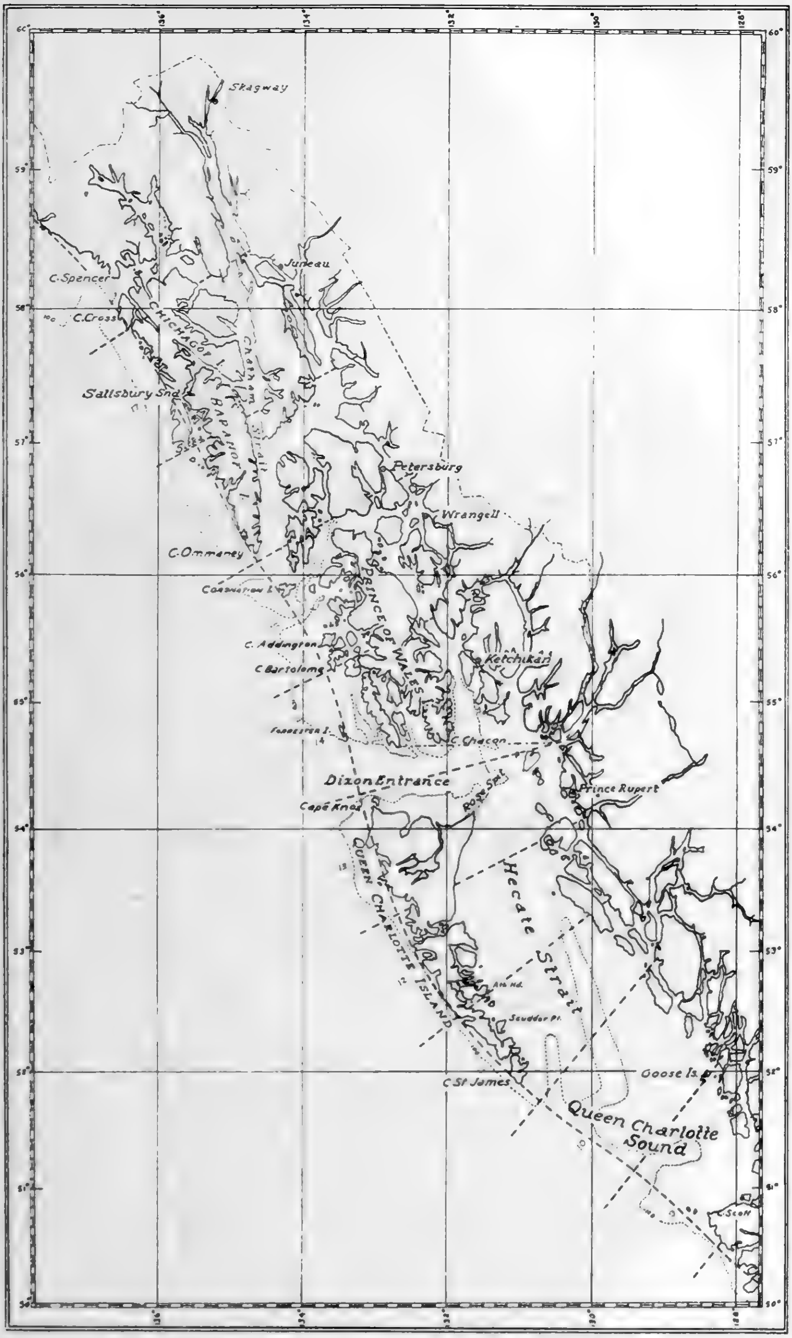

FIGURE 2.—Cape Scott to Cape Spencer

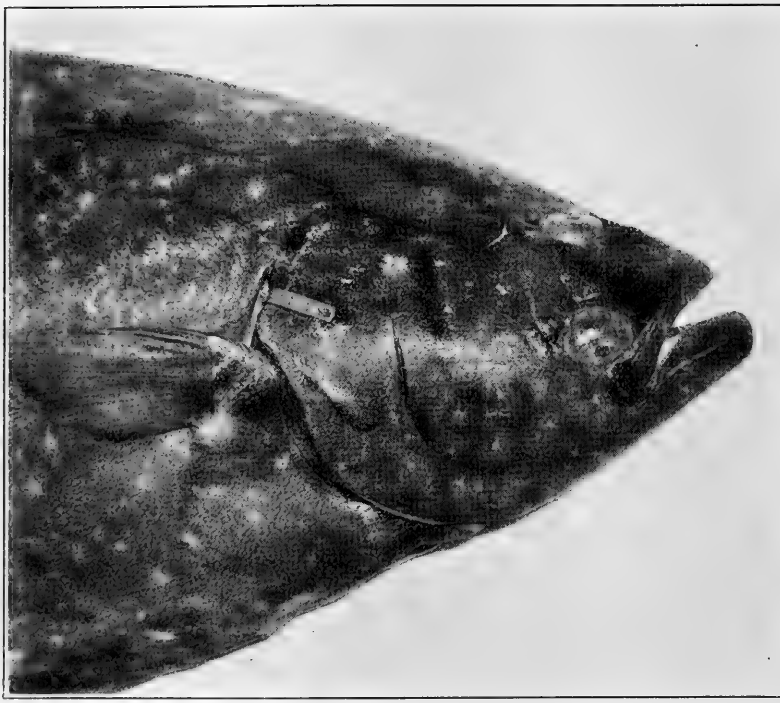

FIGURE 4.—Live halibut ready for liberation with numbered tag on cheek bone

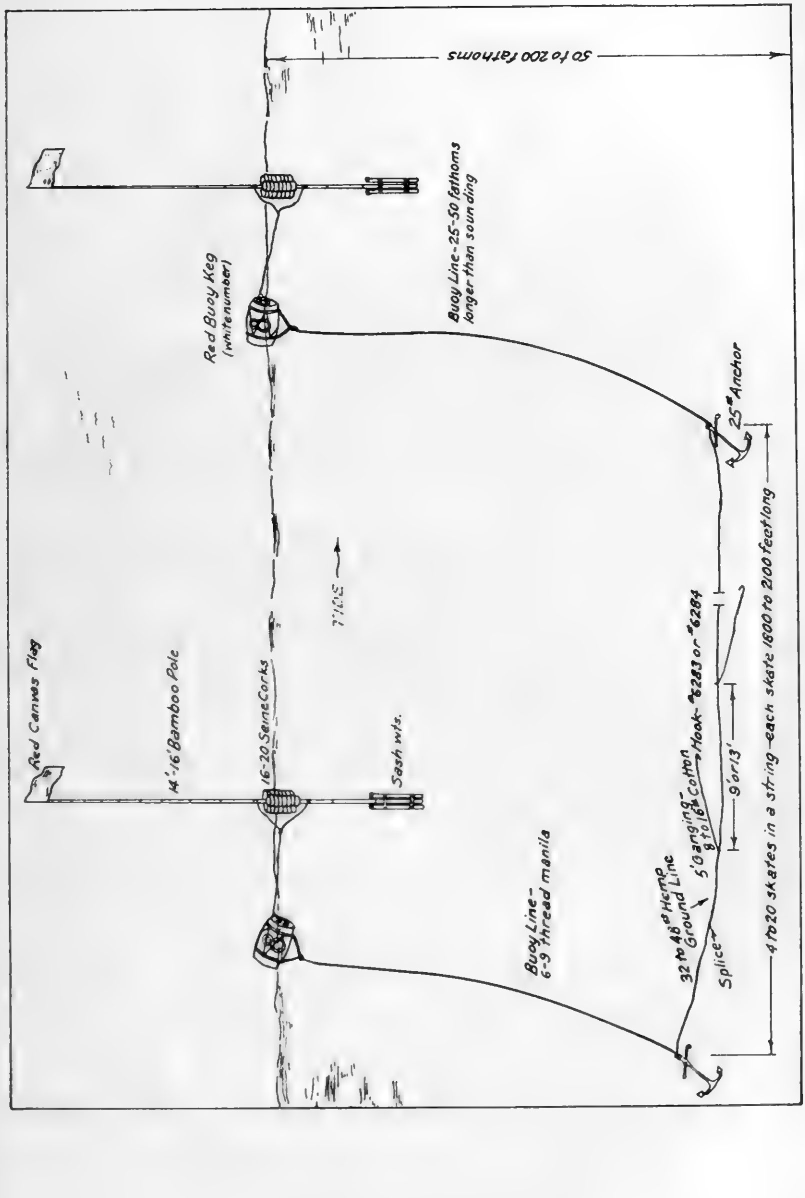

FIGURE 5.—Halibut gear. Ground line made up of units called "skates," set on the bottom and usually baited with herring

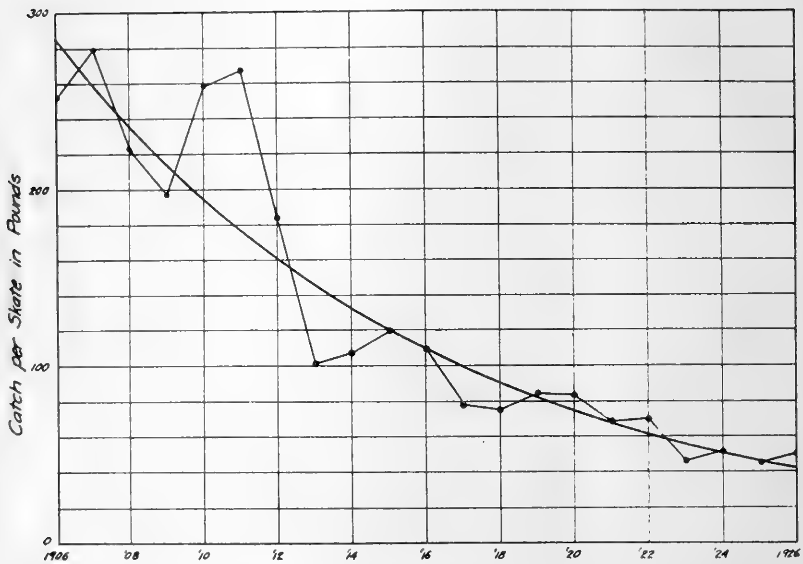

FIGURE 6.—Decline of abundance of fish as shown by the catch in pounds per set of standard gear, the skate. From 1906 to 1926, on the grounds south of Cape Ommaney

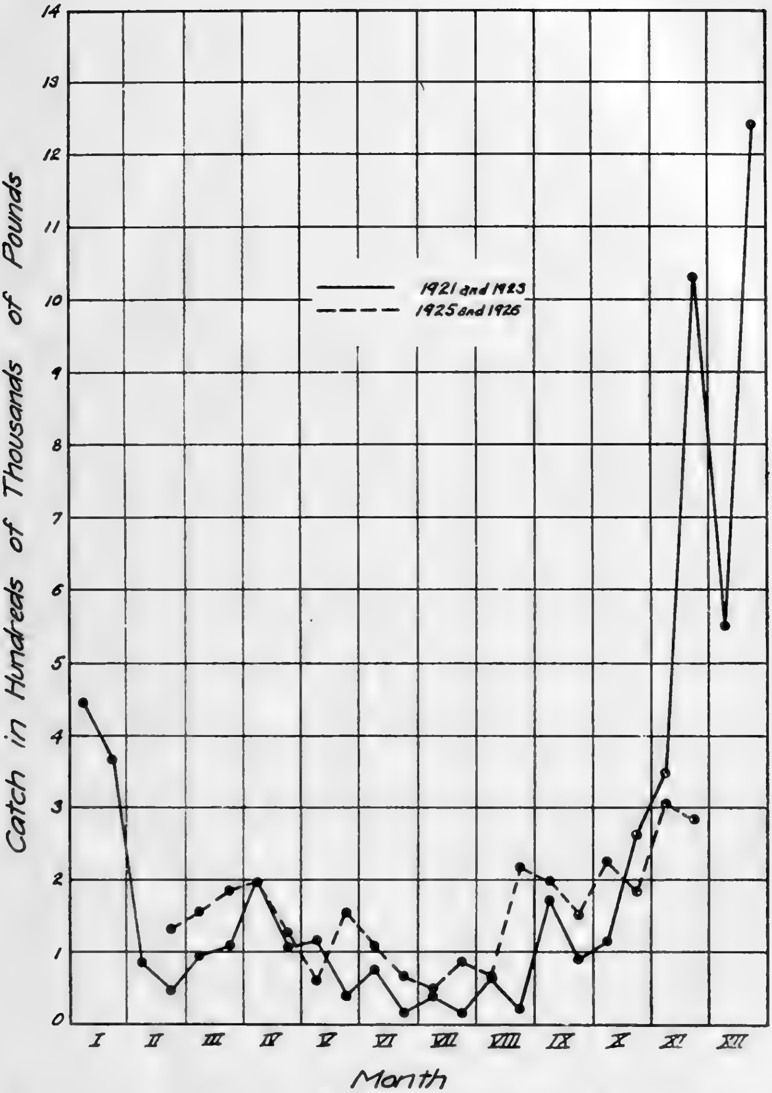

FIGURE 7.—Catch of halibut from the eastern side of the gulf of Alaska, between Cape Spencer and Cape St. Elias, by 2-week periods, as hailed in Prince Rupert. Unbroken line before, and broken line after the closure of the winter season, November 16 to February 15

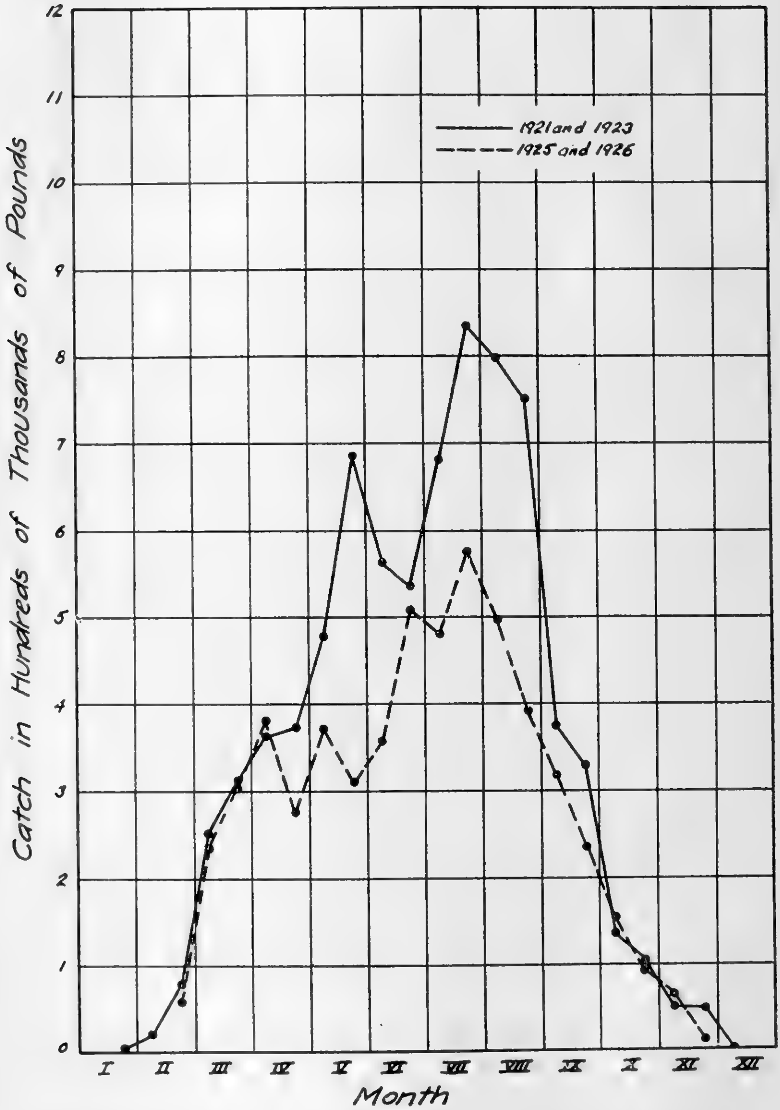

FIGURE 8. Catch of halibut from Hecate Strait and Dixon Entrance, by 2-week periods, as hailed in Prince Rupert. Unbroken line before and broken line after the closure of the winter season, November 16 to February 15

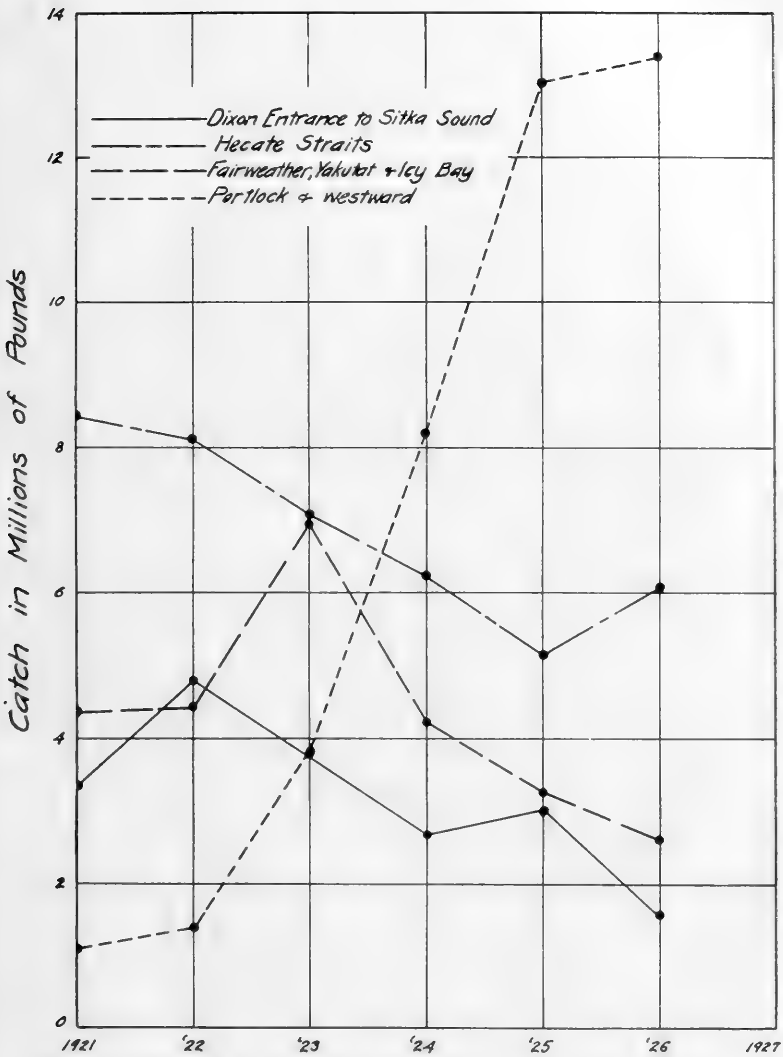

FIGURE 9.—The rise in landings from the westward banks, including Portlock, contrasted with the decline in those from other regions. Prince Rupert, 1921 to 1926

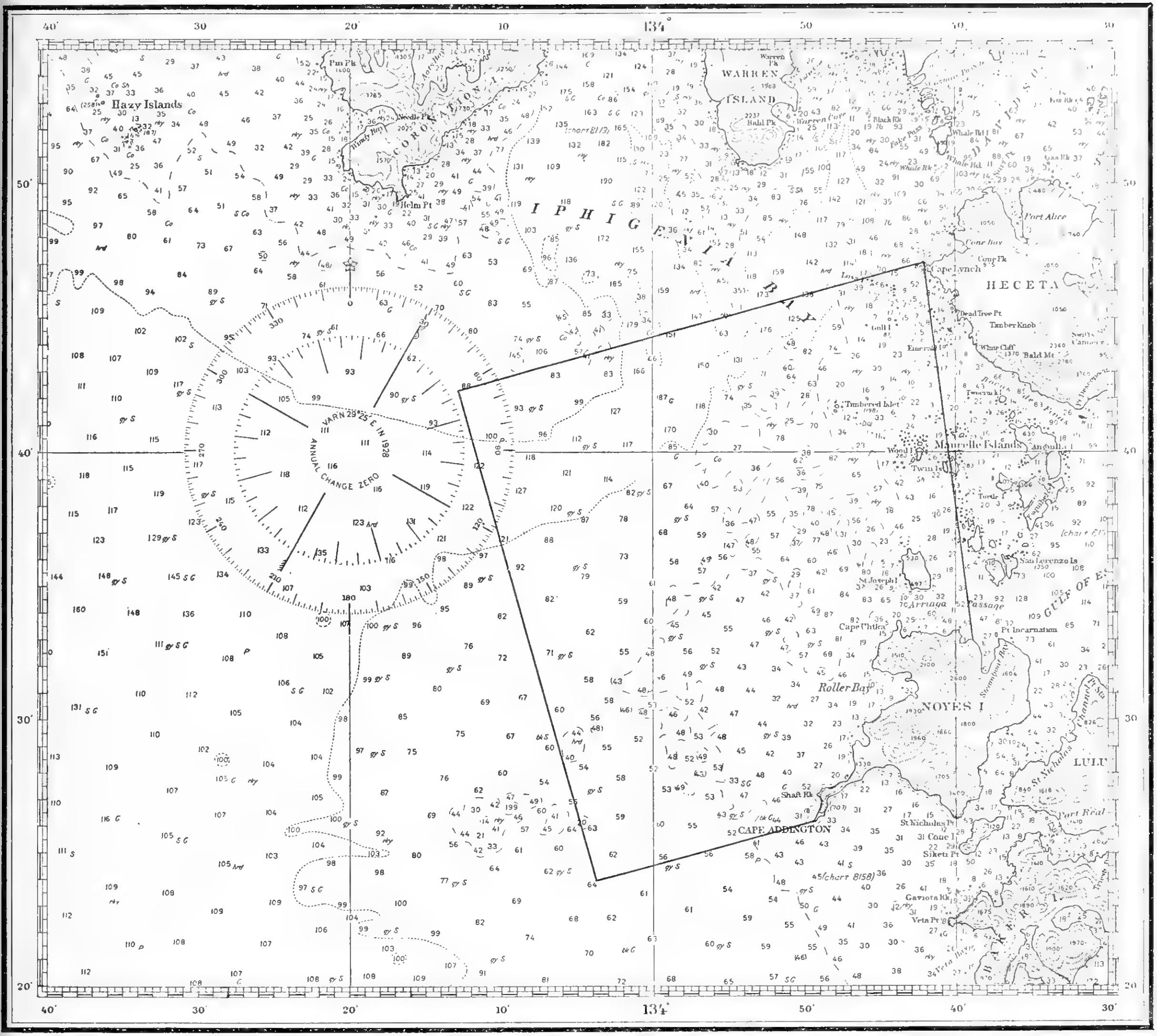

Figure 10.—Proposed Timbered Islet closed "nursery"

87842—30. (Follow p. 25, No. 1.)

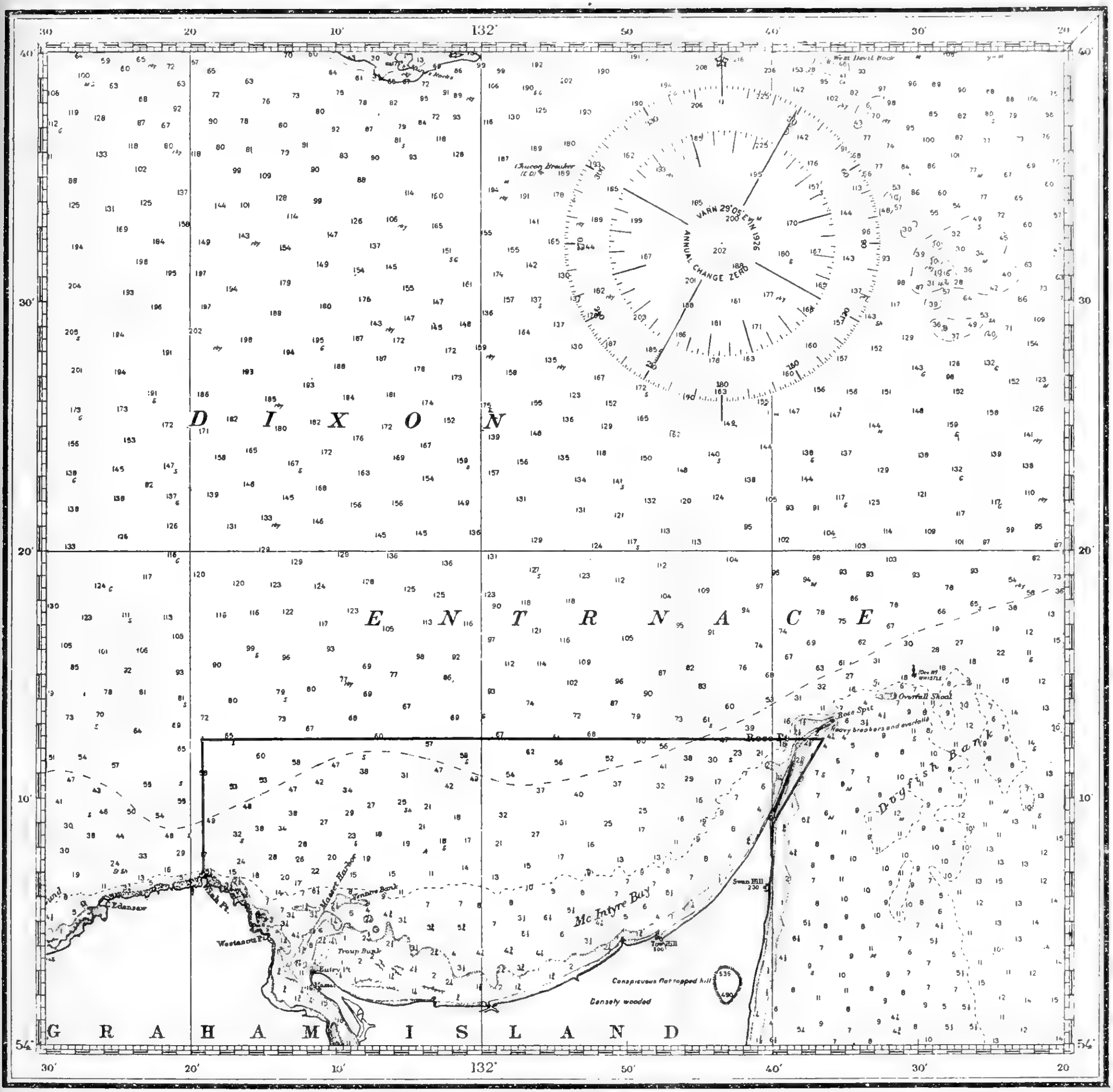

FIGURE 11.—Proposed Massett closed "nursery"   87842—30. (Follow p. 25, No. 2.)

STATISTICS OF THE HADDOCK FISHERY IN NORTH AMERICAN WATERS[1]

By A. W. H. Needler, *University of Toronto*

CONTENTS

INTRODUCTION

The haddock fishery in the western North Atlantic is of considerable importance, and its catches are increasing. In this report certain results of a consideration of the available statistics are presented.

Chiefly, the statistics collected and published by the Governments are considered here, and we are concerned particularly with those giving, directly or indirectly, the weights of the haddock catches made at various times and places. Two subjects on which these data throw light are discussed—(1) changes in the amounts of the catch from year to year and the question of depletion, and (2) the geographical distribution of the haddock catch.

The haddock catches are all given in this report as weights of fresh haddock gutted but with the heads still on. This is the form in which the catches are most often purchased from the fishermen and is referred to as "fresh" in the United States statistics and as "caught and landed (in a fresh or green state)" in the Canadian statistics. The whole weight is about 1.15 times the above weight in the summer and larger in the winter.

NORTH AMERICAN HADDOCK CATCHES SINCE 1880 AND THE QUESTION OF DEPLETION

The statistics of the total haddock catches since 1880 are given below. On account of the diversity of form, those of each country are given separately.

[1]Appendix II to the Report of the U. S. Commissioner of Fisheries for 1930. Bureau of Fisheries Document No. 1074.
Contribution No. 2 from the North American Committee on Fishery Investigation.

NEWFOUNDLAND, FRANCE, AND PORTUGAL

The haddock catches by these countries in North American waters appear in their fishery statistics only very recently. Their small size (a combined catch of about 2 per cent of the North American total) makes their omission of little importance.

UNITED STATES

The statistics of the United States haddock catches were taken from the annual reports of the Commissioner of Fisheries. They fall into two divisions—(1) annual reports on the vessel fisheries of Boston and Gloucester since 1891, and (2) complete surveys of the fisheries of the New England States in 1880, 1887, 1888, 1889, 1902, 1905, 1908, 1919, and 1924. For the latter years the amounts of the New England shore catch and of the vessel catch landed at other ports than Boston and Gloucester were determined. These were considered to have varied evenly between the known catches, and the resulting estimated annual catches were added to those of Boston and Gloucester, giving a figure for the total New England catch each year since 1887. The Boston and Gloucester catches for 1890 and 1892 are averages of those for the adjacent years.

During the years 1922 to 1927 there was a rapid increase in the haddock landings at New York, and annual statistics of the landings in that city were furnished by J. H. Matthews, of the Atlantic Coast Fisheries Co. As practically all the haddock of New York and New Jersey are landed at New York City, these figures were taken as totals for those States. The catches of New York and New Jersey for earlier years were taken from surveys made in the years 1889, 1890, 1891, 1892, 1897, 1898, 1901, 1904, 1915, 1917, 1921, and 1926, and the annual catches were estimated by interpolation. The annual catches of the States of New York and New Jersey were then added to the New England catches to give the total United States catches. These appear in Table 1.

TABLE 1.—*United States catches, shown in pounds, of fresh gutted haddock*

Year	New England shore catch	Boston and Gloucester	Vessel catch landed at other ports	Total New England catch	Middle Atlantic States [1]	Landed at New York City [2]	Total United States catch
1880				[3] 42,800,000			42,800,000
1887	5,500,000	24,100,000	11,200,000	40,800,000			41,000,000
1888	5,500,000	29,700,000	11,700,000	46,900,000			47,100,000
1889	5,400,000	[4] 29,100,000	11,200,000	45,800,000	182,000		46,000,000
1890					174,000		[5] 50,200,000
1891		38,400,000			165,000		[5] 54,700,000
1892					176,000		[5] 52,200,000
1893		34,000,000					[5] 49,700,000
1894		45,600,000					[5] 61,000,000
1895		41,600,000					[5] 56,800,000
1896		30,200,000					[5] 45,200,000
1897		31,000,000			321,000		[5] 45,600,000

[1] New York and New Jersey shore and vessel fisheries.
[2] Statistics furnished by J. H. Matthews, of the Atlantic Coast Fisheries Co.
[3] "Estimated total when fresh" taken from the Fisheries and Fishery Industries of the United States, by G. B. Goode et al.
[4] Vessel catch in Essex and Suffolk Counties.
[5] Estimated, as explained in text.

TABLE 1.—*United States catches, etc.*—Continued

Year	New England shore catch	Boston and Gloucester	Vessel catch landed at other ports	Total New England catch	Middle Atlantic States	Landed at New York City	Total United States catch
1898	6,300,000	32,600,000	7,900,000	46,800,000	413,000		47,200,000
1899		33,300,000					[5] 49,500,000
1900		33,100,000					[5] 45,900,000
1901		29,000,000			388,000		[5] 40,400,000
1902	4,300,000	38,400,000	5,300,000	48,000,000			48,400,000
1903		40,300,000					[5] 50,700,000
1904		48,600,000			448,000		[5] 59,500,000
1905	6,200,000	66,700,000	4,700,000	77,600,000			78,000,000
1906		61,600,000					[5] 73,300,000
1907		42,700,000					[5] 54,300,000
1908	7,300,000	48,700,000	4,600,000	60,600,000			60,900,000
1909		43,200,000					[5] 55,600,000
1910		49,900,000					[5] 62,500,000
1911		56,200,000					[5] 68,900,000
1912		63,500,000					[5] 76,300,000
1913		53,900,000					[5] 66,900,000
1914		57,900,000					[5] 71,000,000
1915		58,100,000			86,000		[5] 71,400,000
1916		55,300,000					[5] 68,700,000
1917		48,500,000			25,000		[5] 61,900,000
1918		60,700,000					[5] 74,300,000
1919	4,600,000	75,900,000	9,200,000	89,700,000			89,700,000
1920		73,400,000					[5] 88,500,000
1921		64,500,000			25,000		[5] 81,000,000
1922		65,600,000				4,300,000	[5] 87,600,000
1923		68,500,000				10,800,000	[5] 98,200,000
1924	8,700,000	73,300,000	11,500,000	93,500,000		14,400,000	107,900,000
1925		83,900,000				14,800,000	[5] 119,100,000
1926		88,000,000			17,020,000	17,900,000	[5] 126,500,000
1927		121,200,000				30,400,000	[5] 174,200,000

[5] Estimated, as explained in text.

Some of the catches were given in part as "salted," the fish under this head being split and salted but not dried. The amount of salted fish was usually very small—about 1 per cent of the total. A factor of 2.0 was used to obtain the fresh weight of these catches. This factor is in current use in the compilation of statistics both in the United States and Canada.

CANADA

The Canadian haddock catches were obtained from the annual reports of the Department of Marine and Fisheries and from the fisheries statistics published by the Dominion Bureau of Statistics—the former from 1880 to 1917 and the latter since 1918. The statistics are based on annual and, since 1911, monthly reports by the fishery overseers. These are compilations of the records of the various firms in their districts.

Before 1910 the statistics do not give the weights of the catch in terms of fresh gutted fish, and this figure must be calculated from the weights of the products marketed. Since 1910 figures are published entitled "Caught and landed in a fresh or green state"; but uniformity throughout the period studied is desirable, and the weights "caught and landed" are themselves at times calculated from the weights of the products marketed—for example, in the case of the Lunenburg catches, which are landed salted, and in those where fish are prepared by the fishermen themselves. For these reasons the Canadian catches given here are the weights of fresh fish gutted but without the heads removed, calculated to be necessary to produce the amounts of the marketed products given in the statistics.

The opinions of eight representative fish firms were obtained in an effort to gain accurate knowledge of the quantitative conversion factors involved in the preparation of the various products from fresh fish. Certain tests also were made under the author's supervision. The results are given below:

Finnan haddie.—One hundred and fifty to 180 pounds of fresh haddock (average 167 pounds) were given as necessary to produce 100 pounds of smoked finnan haddie. Variations are due to differences in trimming and in the condition of the fish—fat fish lose less weight.

Dried haddock.—Three hundred to 450 pounds of fresh haddock were given as necessary to produce 1 quintal (112 pounds) of dried haddock. Variations are due to the degree of salting and drying and the condition of the fish. In tests conducted by the author at Ingonish, Cape Breton, in June, 425 and 450 pounds of fresh gutted haddock produced 1 quintal dried.

Fresh fillets.—Two hundred and fifty to 360 pounds of fresh fish was considered necessary to produce 100 pounds of fresh fillets, depending largely on the method of cutting and trimming.

These figures show the lack of agreement on the quantitative factors involved. The following were regarded as the best available approximations to average conditions:

Finnan haddie.—One hundred and sixty-seven pounds fresh to 100 pounds finnan haddie (smoked haddock).

Dried.—Four hundred pounds fresh to 1 quintal (112 pounds) dried.

Fillets.—Three hundred pounds fresh to 100 pounds salted.

Canned.—One hundred and sixty pounds fresh to one case canned.

The Canadian haddock catches calculated, using these relations, are given in Table 2.

TABLE 2.—*Canadian haddock catches*

Year	Products marketed, in pounds of fresh gutted haddock used					Total catch in pounds of fresh gutted haddock
	Fresh	Smoked	Dried	Salted	Others [1]	
1880			43,600,000			43,600,000
1881			47,100,000			47,100,000
1882			71,500,000			71,500,000
1883			69,200,000			69,200,000
1884			86,800,000			86,800,000
1885			74,400,000			74,400,000
1886			85,400,000			85,400,000
1887			86,400,000			86,400,000
1888			94,900,000			94,900,000
1889			50,300,000			50,300,000
1890			53,200,000			53,200,000
1891			60,000,000			60,000,000
1892			67,000,000			67,000,000
1893			53,300,000			53,300,000
1894			54,900,000			54,900,000
1895		400,000	48,300,000			48,700,000

[1] In order of importance—smoked fillets, canned and fresh fillets.

TABLE 2.—*Canadian haddock catches*—Continued

Year	Products marketed, in pounds of fresh gutted haddock used					Total catch in pounds of fresh gutted haddock
	Fresh	Smoked	Dried	Salted	Others	
1896		1, 900, 000	50, 100, 000			52, 000, 000
1897	3, 500, 000	2, 900, 000	89, 900, 000			96, 000, 000
1898	5, 700, 000	3, 800, 000	49, 700, 000			59, 200, 000
1899	4, 400, 000	4, 100, 000	54, 200, 000			62, 700, 000
1900	5, 300, 000	3, 300, 000	41, 600, 000			50, 200. 000
1901	4, 700, 000	3, 500, 000	52, 300, 000			60, 500, 000
1902	4, 400, 000	3, 500, 000	37, 300, 000			45, 200, 000
1903	8, 100, 000	3, 300. 000	30, 000, 000			41, 400, 000
1904	7, 300, 000	4, 400, 000	35, 200, 000			46, 900, 000
1905	11, 500, 000	4, 500, 000	39, 900, 000			55, 900, 000
1906	10, 500, 000	4, 500, 000	33, 100, 000			48, 100, 000
1907	12, 600, 000	4, 400, 000	30, 000, 000			47, 000, 000
1908	8, 600, 000	5, 500, 000	34, 900, 000			49, 000, 000
1909	11, 000, 000	4, 300, 000	44, 700, 000			60, 000, 000
1910 [2]	16, 400, 000	10, 400, 000	33, 700, 000			60, 500, 000
1911 [2]	24, 600, 000	12, 900, 000	17, 300, 000			54, 800, 000
1912 [2]	19, 600, 000	6, 900, 000	28, 400, 000		1, 200, 000	56, 100, 000
1913 [2]	14, 600, 000	4, 600. 000	25, 600, 000		1, 100, 000	45, 900, 000
1914 [2]	13, 900, 000	12, 100, 000	35, 500, 000	1, 500, 000		63, 000, 000
1915 [2]	15, 400, 000	8, 200, 000	35, 800, 000	4, 100, 000	2. 300, 000	65, 800, 000
1916 [2]	16, 000, 000	6, 600, 000	34, 200, 000	4, 700, 000	3, 800, 000	65, 300, 000
1917	22, 200, 000	6, 900, 000	32, 700, 000	14, 100, 000	2, 100, 000	78, 000, 000
1918	19, 200, 000	9, 300, 000	28, 900, 000	6, 700, 000	6, 000, 000	70, 100, 000
1919	13, 000, 000	6, 400, 000	22, 700, 000	13, 100, 000	5, 400, 000	60, 600, 000
1920	10, 800, 000	11, 300, 000	15, 500, 000	5, 100, 000	2, 800, 000	45, 500, 000
1921	11, 900, 000	6, 700, 000	4, 800, 000	2, 500, 000	1, 000, 000	26, 900, 000
1922	11, 600, 000	9, 200, 000	6, 500, 000	3, 000, 000	1, 300, 000	31, 600, 000
1923	13, 700, 000	8, 100, 000	5, 200, 000	1, 300, 000	2, 100, 000	32, 400, 000
1924	15, 700, 000	6, 700, 000	8, 100, 000	1, 700, 000	2, 200, 000	34, 400, 000
1925	15, 800, 000	5, 400, 000	7, 700, 000	1, 800, 000	5, 400, 000	36, 100, 000
1926	22, 600, 000	8, 900, 000	8, 300, 000	1, 800, 000	8, 600, 000	50, 200, 000
1927	23, 700, 000	4, 500, 000	4, 900, 000	1, 700, 000	4, 900, 000	39, 700, 000

[2] Fiscal year.

Doubt is cast on the accuracy of catches before 1888, when " hake and haddock " are given together in the detailed statistics, when the total for haddock is perhaps only an estimate, and when certain discrepancies occur in the compilation of the provincial totals to make the Canadian totals. The extreme catch in 1897 is due entirely to one county—Digby—which showed an increase of 400 per cent in the catch with no increase in the fishing equipment. This record is considered doubtful in the 1897 report itself, and we place no reliance on it here.

The " offshore " catch (defined in the Canadian statistics as that made on trips lasting more than two days), the inshore catch, and the total are shown in Table 3, all taken from the figures for haddock " caught and landed." The average prices per 100 pounds paid to the fishermen are also shown, as they have a probable bearing on the postwar depression of the catch.

TABLE 3.—*Canadian haddock catches*

Year [1]	Catches "caught and landed" (pounds)			Price per hundredweight, "caught and landed"
	Offshore [2]	Inshore	Total	
1910			45, 700, 000	$1.45
1911			53, 000, 000	1.40
1912			50, 400, 000	1.65
1913			40, 600, 000	1.90
1914			56, 600, 000	1.60
1915			58, 300, 000	1.35
1916			58, 200, 000	2.05
1917			71, 200, 000	2.25
1918	25, 200, 000	30, 200, 000	55, 400, 000	3.35
1919	19, 100, 000	37, 300, 000	56, 400, 000	2.40
1920	23, 400, 000	20, 800, 000	44, 200, 000	2.00
1921	6, 700, 000	20, 200, 000	26, 900, 000	1.75
1922	8, 500, 000	22, 200, 000	30, 700, 000	1.75
1923	13, 900, 000	16, 600, 000	30, 500, 000	1.65
1924	14, 800, 000	19, 000, 000	33, 800, 000	1.80
1925	17, 100, 000	17, 300, 000	34, 400, 000	1.90
1926	26, 400, 000	23, 200, 000	49, 600, 000	1.80

[1] For 1910–1916, inclusive, the catch is given for the fiscal year.
[2] An "offshore" catch is made on a trip lasting more than 2 days.

CHANGES IN THE HADDOCK CATCH

The United States and Canadian haddock catches and the total catch for North America since 1889 are summarized in Table 4 and Figure 1. Disregarding the unreliable records before 1889 we can see no significant changes in the total haddock catch before 1903—

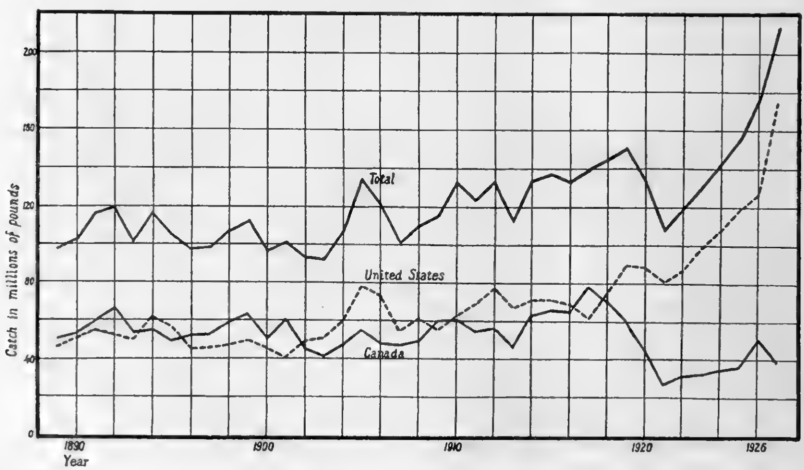

FIGURE 1.—Catches of haddock in North America, given as the weight of fresh haddock, gutted but with the heads still on

only minor fluctuations, with no general increase or decrease. From about that year to 1919 there is a distinct increase with fluctuations. A sudden depression followed, with a minimum catch in 1921, since which there has been a steady increase. To repeat: From a catch of about 100,000,000 pounds in about 1900 the total increased with considerable fluctuations to about 150,000,000 pounds in 1919, decreased to 108,000,000 pounds in 1921, and reached 214,000,000 pounds in 1927.

TABLE 4.—*Total catches in North American waters, in pounds, of fresh gutted haddock*

Year	Canada [1]	United States	Total [1]	Year	Canada [1]	United States	Total [1]
1880	43,600,000	42,800,000	86,400,000	1904	46,900,000	59,500,000	106,400,000
1881	47,100,000			1905	55,900,000	78,000,000	133,700,000
1882	71,500,000			1906	48,100,000	73,300,000	121,400,000
1883	69,200,000			1907	47,000,000	54,300,000	101,300,000
1884	86,800,000			1908	49,000,000	60,900,000	109,900,000
1885	74,400,000			1909	60,000,000	55,600,000	115,600,000
1886	85,400,000			1910	60,500,000	62,500,000	133,000,000
1887	86,400,000	41,000,000	147,200,000	1911	54,800,000	68,900,000	123,700,000
1888	94,900,000	47,100,000	142,000,000	1912	56,100,000	76,300,000	132,400,000
1889	50,300,000	46,000,000	96,300,000	1913	45,900,000	66,900,000	112,800,000
1890	53,200,000	50,200,000	103,400,000	1914	63,000,000	71,000,000	134,000,000
1891	60,000,000	54,700,000	114,700,000	1915	65,800,000	71,400,000	137,200,000
1892	67,000,000	52,200,000	118,200,000	1916	65,300,000	68,700,000	133,800,000
1893	53,300,000	49,700,000	103,000,000	1917	78,000,000	61,900,000	139,900,000
1894	54,900,000	61,000,000	115,900,000	1918	70,100,000	74,300,000	144,400,000
1895	48,700,000	56,800,000	105,500,000	1919	60,600,000	89,700,000	150,300,000
1896	52,000,000	45,200,000	97,200,000	1920	45,500,000	88,500,000	134,000,000
1897	[2] 52,400,000	45,600,000	98,000,000	1921	26,900,000	81,000,000	107,900,000
1898	59,200,000	47,200,000	106,400,000	1922	31,600,000	87,600,000	119,200,000
1899	62,700,000	49,500,000	112,200,000	1923	32,400,000	98,200,000	130,600,000
1900	50,200,000	45,900,000	96,100,000	1924	34,400,000	107,900,000	142,300,000
1901	60,500,000	40,400,000	100,900,000	1925	36,100,000	119,100,000	155,200,000
1902	45,200,000	48,400,000	93,600,000	1926	50,200,000	126,500,000	176,700,000
1903	41,400,000	50,700,000	92,100,000	1927	39,700,000	174,200,000	213,900,000

[1] Canadian catches before 1888 unreliable (see text).
[2] Estimated by replacing the extraordinary catch of Digby County, Nova Scotia, by the average for the 2 adjacent years.

Considering the two countries separately, we see that both the United States and Canadian catches show a general increase from 1903 to 1917. The United States catch, however, fell off only very slightly from 1919 to 1921, the postwar depression of the total catch being due largely to a decrease in that of Canada from 78,000,000 pounds in 1917 (the largest recorded) to about 27,000,000 pounds in 1921 (the smallest recorded). Reference to Table 3 shows that this depression of the catch was coincident with a fall in the prices paid to the fishermen. It was apparently due to economic factors at the close of the war rather than to any decrease in the abundance of the fish. "The marketing of fish and fish products was found to be difficult and prices fell to a figure which made it impossible, in some districts of the Atlantic coast especially, to carry on." (Report of the Deputy Minister of Marine and Fisheries, Canada, 1921.) This decrease was general, affecting both offshore and inshore fisheries and all parts of the coast. On the whole, the recovery has been slow, particularly in the shore fisheries.

CANADA

The inshore and offshore catches are not given separately before 1918. They are shown since that date in Table 3. It may be seen that they are similar in size at the beginning and end of the period

1918 to 1926, but that the offshore catch shows a greater depression and a quicker recovery during the period. The net result has been a relative gain for the offshore catches, which may be attributed largely to the otter-trawl fishery.

UNITED STATES

In the United States the inshore catch is not as important as in Canada. Reference to Table 1 shows that it has increased, but that the increase in the United States total catch has been largely due to greater landings in the New England and New York vessel fisheries. This has been accompanied by the increased use of the otter trawl.

OTTER-TRAWL FISHERY

The increasing importance of the otter-trawl fishery has been one of the most striking developments in the North American haddock fishery in the last 20 years. Otter trawls were first used in the United States for the haddock fishery in 1905, when one steam trawler was operated from Boston. They were introduced later in Canada and have taken an increasingly important part in the fishery in both countries. In 1926 11 steam otter trawlers were fishing on the Canadian Atlantic coast, and their catch was a large proportion of the Canadian offshore catch of haddock. Unfortunately, records of the Canadian catches by otter trawlers have not been kept separate from those of the offshore line fishery. In the United States the otter-trawl fishery has assumed larger proportions than in Canada. Most of the catches landed at New York City since 1922 have been made by otter trawlers. Statistics of the New England otter-trawl fishery are given in Table 5. The catches have been landed chiefly at Boston and also at Portland and Gloucester. Haddock have consistently constituted over 80 per cent of the otter trawlers' catches, and this may be considered principally a haddock fishery. Since the first otter trawler operated in 1905 the fleet has increased, reaching 12 in number by 1915 and averaging about 30 since 1920. Since 1920 its haddock catch has been about one-half of the total for New England.

Changes in the fishery are evident in Table 5, both in the figures for the individual years and in the averages for the two periods for which statistics are available—1908–1915 and 1920–1927. Comparing these two periods, we see that the catch per trip has increased over 50 per cent. The number of trips per trawler has decreased, however, and the catch per trawler is lower for the later period and high again in 1927. Before 1915 the otter-trawl fishery was confined largely to Georges Bank and the South Channel, while in recent years considerable catches have also been made on Nantucket Shoals, Western Banks, and other grounds. The same changes in the fishery, however, are shown when only Georges Banks and the South Channel are considered.

TABLE 5.—*New England otter-trawl fishery for haddock*

Year	Catch, in pounds, of fresh haddock	Catch as percentage of total	Number of trips	Catch per trip (pounds)	Number of trawlers	Number of trips per trawler	Catch per trawler (pounds)
1905					1		
1906					1		
1907					1		
1908	1,500,000	3	44	35,000	1	42	1,500,000
1909	1,700,000	4	47	36,800	1	47	1,700,000
1910	2,800,000	5	59	47,000	1	59	2,800,000
1911	7,400,000	11	178	41,400	3	59	2,470,000
1912	13,000,000	18	295	44,000	[1] 6	49	2,170,000
1913	12,500,000	22	326	38,200	[1] 9	36	1,370,000
1914	15,400,000	23	387	39,700	[2] 11	35	1,400,000
1915	17,100,000	26	380	45,000	12	32	1,420,000
1919					27		
1920	52,000,000	65	646	80,400	44	15	1,180,000
1921	26,700,000	40	346	72,300	26	13	1,030,000
1922	35,900,000	51	578	62,000	28	21	1,710,000
1923	35,500,000	48	665	53,400	33	20	1,080,000
1924	35,200,000	44	543	64,300	32	17	1,100,000
1925	44,000,000	48	607	72,500	29	21	1,520,000
1926	52,400,000	60	667	78,500	30	22	1,750,000
1927	69,200,000	53	794	87,200	25	32	2,170,000
Average, 1908-1915	8,900,000	14	215	40,900	5.5	45 [4] 40	1,840,000 [5] 1,620,000
Average, 1920-1927 [3]	43,900,000	51	606	71,300	31	20.1 [4] 19.6	1,440,000 [5] 1,420,000

[1] Including 1 from New York for part of the year.
[2] Including 2 from New York for part of the year.
[3] Averages of figures calculated for each year.
[4] Average number of trips divided by average number of trawlers.
[5] Average total catch divided by average number of trawlers.

The extent to which the above data indicate changes in the abundance of the fish is very doubtful. The increased catch per trip is rather an indication of a change in the nature of the trawlers enabling them to make longer trips. This is borne out by the decreased number of trips made by a trawler each year. The catch per trawler is probably the nearest approach to the catch per unit of fishing effort, which is our only criterion of the relative abundance of the fish. But we have just pointed out one change in the mode of operation, and others are probable both in the fishing ability of the average trawler and in the average length of time spent in fishing each year. These changes influence the catch per trawler and make it unreliable as an indication of the abundance of the fish.

CHANGES IN THE DISTRIBUTION OF THE CATCH OF THE BOSTON AND GLOUCESTER VESSEL FISHERIES

In Table 6 the geographical distribution of the Boston and Gloucester vessel fisheries is summarized for two periods—1891 to 1901 and 1916 to 1925, both inclusive. The grounds east and west of 66° west longitude are totalized separately.

TABLE 6.—*Geographical distribution of the catch of the Boston and Gloucester vessels fisheries, in pounds, of fresh gutted haddock*

Fishing ground	Average for 1891 to 1901		Average for 1916 to 1925	
	Catch	Percentage of total catch	Catch	Percentage of total catch
La Have Bank	2,049,000	5.9	683,000	1.0
Western Bank	396,000	1.1	5,721,000	8.5
Quereau Bank	24,000	.1	713,000	1.1
Cape Shore	601,000	1.7	597,000	.9
Other grounds E. of 66° W. longitude	[1] 1,000	0	[2] 115,000	.2
Total E. of 66° W. longitude	3,071,000	8.9	7,939,000	11.8
Browns Bank	1,143,000	3.3	4,731,000	7.1
Georges Bank	11,391,000	32.9	16,308,000	24.3
Cashes Bank	855,000	2.5	25,000	.04
Middle Bank	1,861,000	5.4	850,000	1.3
Jeffreys Ledge	1,686,000	4.6	1,392,000	2.1
South Channel	8,097,000	23.4	28,105,000	41.9
Nantucket Shoal	427,000	1.2	1,846,000	2.8
Off Highland Light	1,197,000	3.4	3,000	0
Off Chatham	956,000	2.8	3,430,000	5.1
Other grounds W. of 66° W. longitude	[3] 3,893,000	11.3	[3] 2,420,000	3.6
Total W. of 66° W. longitude	31,507,000	91.1	59,110,000	88.2
Grand total	34,578,000	100.0	67,049,000	100.0

[1] Canso Bank only.
[2] Including, in order of importance, Grand, St. Peters, Misaine, and St. Anns Banks, Cape North, and the Gulf of St. Lawrence.
[3] Principally (90 per cent) on inshore grounds.

Considering first only these large divisions, we see that the catch from the nearer grounds doubled and that from the more distant grounds more than doubled between the two periods. The latter increased from 8.9 to 11.8 per cent of the total, a change hardly great enough to be regarded as showing a significant shift of the fishery farther afield.

The catches on individual grounds changed greatly in relative size. Actual decreases occurred in the catches on La Have Bank, Cape Shore, Cashes Bank, Jeffreys Ledge, off Highland Light, and Middle Bank. On all of these the line fishery preponderates. The two former are close to the coast of Nova Scotia just east of Cape Sable; the rest are in the southwestern part of the Gulf of Maine. On Georges Bank, on which the line catches remained greater than the otter-trawl catches, the catch increased, but the percentage of the total catch decreased from 33 to 24 per cent. The percentage of the total catch increased on Quereau Bank, Browns Bank, Western Bank, in the South Channel, on Nantucket Shoals, and off Chatham. The haddock catches are made chiefly with otter trawls on all these grounds except Quereau and Browns Banks where they are made entirely with lines.

Thus, greatly increased haddock catches were made in the later period on those grounds where the otter-trawl fishery predominated. Of the grounds where there was no otter trawling the nearer showed greatly decreased catches and Browns Bank showed greatly increased catches, while the total line catch east of 66° remained about the same. Although the total haddock catch does not show a general decrease on the nearer grounds accompanied by increases farther afield, the line fishery by itself does so, and the increases on the nearer grounds are due to the otter-trawl fishery.

THE QUESTION OF DEPLETION

It has been shown above that since 1903 there has been a definite tendency for the haddock catch to increase both in the United States and Canada. Although the Canadian catch has been set back by economic conditions following the war, the total catch has continued to increase. This fact by itself does not eliminate the possibility of depletion. It might be that increasing fishing effort has produced increasing catches with decreasing abundance of the haddock. Sufficient data are not available for the earlier years to test this. The annual catch per otter trawler is the nearest approximation available to the catch per fishing effort. Although small on the average since 1920, it was large again in 1927, and no lasting scarcity of haddock is indicated. In the preceding section it is shown that the grounds to the south of the Gulf of Maine fished longest and most intensively still yield the greatest haddock catches. No general decrease of the catch on the near grounds and shift of the fishery farther afield are in evidence.

Fluctuations in the abundance are to be expected, due to the variability in the survival of successful year classes to attain commercial size, which has been found both in Europe and America. Local scarcity is probable in both inshore and offshore grounds, but no general or lasting depletion is evident from the available statistics. It must be borne in mind, however, that sufficient data are not available to make this lack of evidence conclusive.

GEOGRAPHICAL DISTRIBUTION OF THE NORTH AMERICAN HADDOCK CATCH

PREPARATION OF THE CHART

In Figure 2 an attempt has been made to represent, quantitatively, the distribution of the haddock catch in North American waters for the years 1917 to 1925. Each circular dot represents an average annual catch of 200,000 pounds in the locality represented by its position. Vertical crosses indicate small catches recorded in the various fisheries statistics. Diagonal crosses represent other records of the occurrence of a few haddock in commercial catches.

The average annual inshore and offshore catch landed in each county on the Canadian coast was calculated for the period 1917 to 1925. The detailed distribution of the Canadian offshore catches was estimated from information provided by the overseers in whose districts they were landed and by members of the industry.

The average annual catch landed at Boston, Gloucester, and Portland from each fishing ground was calculated from the annual statistics published. It was assumed that the catches landed at New York were made on similar grounds to those of Boston. For the shore fisheries and vessel fisheries other than the above (amounting together to about 15 per cent of the total United States catch) the chart is based on the average catch in each State for the years 1919 and 1924.

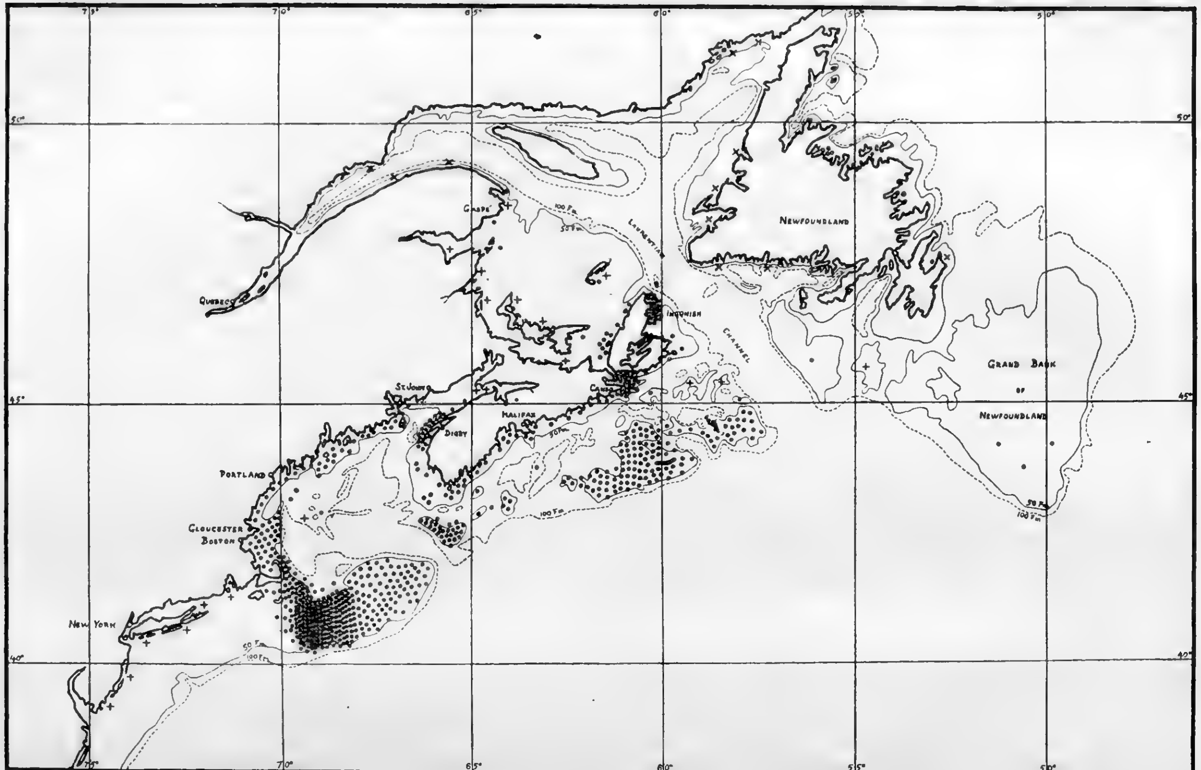

FIGURE 2.—Distribution of the North American haddock catch, 1918 to 1925. Dots represent average annual catches of 200,000 pounds; upright crosses represent small catches; diagonal crosses represent records of the occurrence of hadddock in catches of cod

The distribution of the catch within the areas for which it is recorded—for example, on different parts of the same banks—is not reliable. As the chart is on Mercator's projection the areas to the south are represented on a slightly smaller scale, and the catch appears more concentrated than is the case to the north.

CATCH

The more important features of the distribution may be seen in the chart (fig. 2). The greatest catch is made in the neighborhood of the South Channel, extending over Georges Bank on the east and to Cape Cod on the west. West of Cape Cod only very small catches are made, extending to Cape May. In the Gulf of Maine considerable catches are made inshore along the entire coast. Large catches are made on the south shore of the Bay of Fundy near the mouth, but they decrease markedly toward the head of the bay; on the north shore there is no commercial catch east of St. John.

Fair catches are made along the entire coast of Nova Scotia from Cape Sable to Cape North, Cape Breton, with large catches in the vicinity of Canso and Ingonish, where haddock are taken in trap nets. Large catches are made on the banks off this coast, particularly Browns, Western, and Quereau Banks.

In the Gulf of St. Lawrence, with the exception of a fair catch on the Cape Breton coast, only very small catches are made in spite of a great deal of line and trap-net fishing for cod. These small catches extend throughout Magdalen Bay. The very small catches elsewhere in the gulf are not mentioned in the statistics.

On the banks south and east of Newfoundland very small catches are made by United States vessels. The French catch on Newfoundland Bank (including all French catches in North American waters) is very small—about 200,000 pounds annually. Records of Canadian, Newfoundland, and Portuguese catches in this area are not available, but they are probably small. They are estimated at not over 600,000 pounds, but their amount and distribution are very uncertain.

It must be remembered that the chart shows the catches and not the abundance of the haddock. The presence of a large haddock catch is indicative of the abundance of haddock, but the relative abundance at various places can not be judged safely from the catches. The absence of a haddock catch has significance only where a fishery exists using gear that will catch haddock.

SUMMARY

1. The total haddock catches in North American waters since 1880 are summarized in Table 4 and Figure 1. The total catch has shown an increase from about 100,000,000 pounds in 1900 to about 214,000,000 pounds in 1927.

2. The postwar depression of the catch was relatively small in the United States. In Canada the decrease from 78,000,000 pounds in 1917 to 27,000,000 pounds in 1921 was due apparently to economic factors. It was most marked in the offshore fishery but also very general inshore.

3. The inshore and offshore catches are given for the United States in Table 1 and for Canada in Table 3. The increasing total haddock

catch is attributable largely to increasing vessel catches and the development of otter trawling.

4. The development of the New England otter-trawl fishery is summarized in Table 4. Beginning in 1905, from 1920 to 1927 its catch averaged about one-half of the New England vessel catch and was made by about 31 steam trawlers. Since 1920 longer trips have been made with increased catches per trip. The catch per trawler has been low since 1920, but was high again in 1927.

5. The landings at Boston and Gloucester from various grounds during the period 1891 to 1901 and 1916 to 1925 are summarized in Table 6. The total haddock catch does not show a decrease on nearer grounds accompanied by increase farther afield. The line fishery by itself does so, increases on the nearer grounds being due to the otter-trawl fishery.

6. No general or lasting depletion is evidenced by the available statistics.

7. The geographical distribution of the North American haddock catch is shown in Figure 2. The catch is made chiefly from Cabot Strait to Cape Cod, being greatest in the South Channel and the vicinity. Large catches are made on Georges, Browns, and the Sable Island Banks. With the exception of the head of the Bay of Fundy, considerable catches are made along the entire coast from Cape Cod to Cape North, with large catches near Digby, Canso, and Ingonish. Small catches are made in the southern part of the Gulf of St. Lawrence.

O

NET PRESERVATIVE TREATMENTS[1]

By W. T. Conn

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INTRODUCTION

Of the commercial catch of fish in the United States and Alaska, about $75,000,000 worth is taken by means of textile webbing which, when combined with other materials, is commonly referred to as nets. The size, form, and quality of these vary with the size and species of fish sought. The investment in fishing nets in the United States and Alaska amounts to about $16,000,000 when the value of the rope, floats, leads, and other accessories are added to the value of the webbing. From this it can be seen that the value of nets alone constitutes about 20 per cent of the value of the catch made by them annually.

The factory value of textile webbing used for replacement of nets annually is about $5,400,000. This figure would be increased considerably if the cost of merchandising, labor, and transportation were added. Thus, the maintenance of replacement of nets represents a considerable proportion of the cost of fish landed, and preservative treatments which will prolong the life of these nets are of economic importance, not only to the fisherman or producer, but also to the consumer of fishery products.

Replacement of textile fishing gear is necessary, due largely to deterioration which is partly controllable. When the best preservatives are used the loss of tensile strength and losses due to storm damage are minimized, with the result that more fish can be taken with a certain quantity of gear. Fishermen can not eliminate damage from driftwood, violent storms, and possibly from destruction of nets by sharks, but it is generally recognized that a clean net is less liable to storm damage, as it offers a minimum resistance to the motion of the water. Preservatives are available which, when applied to certain types of textile webbing, impart to it a high resistance to mechanical abrasion.

Members of the technological staff of the Bureau of Fisheries have devoted the past several years to a study of net preservatives. They have tested many formulas over a long period of time under actual fishing conditions. It is the purpose of this paper to discuss those treatments which it is believed will have the greatest promise of efficient preservatives. As a result of the investigations it has been found that the quantity and quality by fouling of textile fishing gear varies widely in different waters. Bacterial decomposition of nets has been proved in certain localities, and it is suspected in others. In certain types of nets, contamination of the webbing

[1] Appendix III to the Report of the U. S. Commissioner of Fisheries for 1930. B. F. Doc. 1075.

by fish slime and subsequent atmospheric exposure of the nets leads to heating due to bacterial action, which is controllable, so far as is known now, only by thorough washing of the nets, followed by salting.

Preservative treatments applied to gill nets which are fouled during immersion should not only minimize aquatic growths but must also leave the webbing soft and pliable and capable of flattening when struck by fish. In contrast, purse seines, which are immersed for relatively short periods and in which fouling is caused exclusively by contact with the fish, require a preservative that will maintain tensile strength and resist abrasion; a round, smooth, compact thread is desirable, and a high degree of flexibility appears to be of minor importance. These two examples will suffice to point out that no one preservative formula is applicable to all types and sizes of textile fishing gear.

In the application of preservatives in which tar is a principal constituent it is necessary to provide a kettle of convenient size that can be heated to 250° F., a draining board, and tackle for hauling out the hot net. For the lighter treatments, in which solvents are used, a tank that can be heated with a closed steam coil is the only essential equipment, although a draining board is sometimes used. The preservative treatments listed below are on the basis of 100-pound mixes. These mixes will have to be increased or decreased according to the size of the twine and the quantity of the nets to be preserved. Those treatments for pound or trap nets and gill nets which contain copper compounds other than bluestone were developed by technologists of the Bureau of Fisheries.

TREATMENTS FOR POUND NETS

No preservative developed up to the present time has demonstrated its ability to prevent absolutely the growth of vegetable material on trap-net webbing in all waters. When this material persists in forming it may be killed by removing the nets from the water and exposing them to the bright sunlight for a day. The most general treatment used for preserving pound or trap nets consists of the following ingredients:

	Pounds
Coal tar	67
Wood tar	33

A coal tar low in residue (benzol insoluble) is recommended. This mixture is heated to fuming temperature in a kettle. The net is immersed in the tar for a few minutes and then drained, after which it is ready for use. This treatment is fairly satisfactory for nets exposed in fresh water. For nets exposed in salt water the treatment becomes somewhat exhausted in about one month and fouling with vegetable growth becomes quite extensive. However, this treatment has the advantage of low initial cost and produces a net with a good resistance to abrasion, the latter being an important consideration with pound or trap nets. A tarred net is relatively heavy and inflexible, and the treatment is attended by some fire risk and considerable discomfort to the laborers applying the treatment.

A preservative for pound or trap nets, which gives promise of a higher resistance to vegetable growth, consists of the following ingredients:

	Pounds
Coal tar	62
Wood tar	31
Red oxide of copper	7

The red oxide of copper should be "Navy standard," that is, containing not less than 88 per cent cuprous oxide and fine enough so that 98 per cent can be sieved through a 350-mesh screen. This should be added last in making the mixture. The mixture should be stirred while the net is being treated.

Another preservative treatment for pound or trap nets, which leaves the webbing more pliable and resistant to abrasion, consists of the following ingredients:

	Pounds
Coal tar	50
Copper oleate	15
Benzol (4¾ gallons)	35

Copper oleate containing not less than 8 per cent of copper should be used. Benzol is highly inflammable and slightly poisonous, so that extreme caution should be used in handling this mixture. Ordinarily, in warm weather, the mixture can be effected without heat. In cold weather to make the mixture it may be necessary to heat the kettle containing the mixture with a closed steam coil. *In all events the mixture should be kept away from open fires at all times.*

A most satisfactory preservative treatment for producing a lightweight pound or trap net consists of the following ingredients:

	Pounds
Coal tar	12
Wood tar	6
Red oxide of copper	5½
Water gas tar oil (9 gallons)	76½
Red oxide of mercury (2 ounces)	⅛

The oxide of mercury should be as fine as possible and should be ground thoroughly together with the red oxide of copper before they are added to the other ingredients. The water gas tar oil is a by-product of the coal-tar industry and ordinarily may be obtained from the refiners at a cost of about 25 cents per gallon in 50-gallon drums. This material is about as inflammable as kerosene and should be handled with reasonable caution. Mixtures containing it should be used at a temperature well above blood heat (about 150° F.) to insure complete solution of the solvent components. In using the above mixture, clean dry webbing should be immersed for at least five minutes with constant agitation of the mixture to insure against settling of the heavy solids. To guard against this, it has been found excellent practice to operate a bilge pump in the center of the kettle or tank in order to draw the mixture from the bottom of the tank and distribute it over the section of the net being treated.

This treatment has produced webbing which, under adverse conditions, has maintained full strength for one year without fouling, although it should not be inferred that similar results will always be obtained. The only objection to this treatment is that the webbing has a comparatively low resistance to abrasion.

A preservative treatment for pound and trap nets which produces an extremely lightweight and flexible webbing consists of the following ingredients:

	Pounds
Copper oleate	30
Gasoline or kerosene (about 9½ gallons)	70

After the copper oleate has been dissolved in the gasoline or kerosene the clean, dry webbing should be soaked for at least five minutes in the mixture, then drained and dried, when it is ready for use. The treatment is reasonably satisfactory for six weeks in salt water and for a shorter period in fresh water. Somewhat better results may be obtained by using the above mixture diluted with an equal quantity of gasoline or kerosene and repeating the treatment twice as often on clean, dry webbing.

TREATMENTS FOR GILL NETS

Investigations on the preservation of gill nets have been conducted by the bureau's technologists on gill nets which have been exposed in Lake Erie waters, where losses are more serious than generally in fresh water. In Lake Erie a green slime accumulates upon gill nets, and, while it appears to have a minor influence upon the tensile strength, the fouling lessens the catch. A net covered with green slime may be restored to ordinary condition by thorough washing and then exposing upon a reel to bright sunlight. Continued exposure of this nature is detrimental, and so after the washed net is thoroughly dried, it should be hung in the shade.

The more serious fouling of nets in Lake Erie waters is due to two cellulose digesting bacteria which have been isolated from so-called red slime. Microscopic examinations reveal that the bacteria are found in the lumen of the cotton hairs and, apparently, there is a progressive deterioration of the cellulose material from the lumen outward. Gill-net webbing on which a red slime appears may disintegrate within a few hours unless the slime is washed off.

The following treatment (identical with that for pound or trap nets) may be used to advantage:

	Pounds
Copper oleate	30
Gasoline or kerosene (about 9½ gallons)	70

This treatment reduces the danger from red slime but increases the liability of knots slipping when the fish are removed from the net. To overcome this objection as far as possible the bureau's technologists have developed the following treatment:

	Pounds
Copper oleate	20
Copper resinate	10
Gasoline or kerosene (about 9½ gallons)	70

The copper oleate should contain not less than 8 per cent copper.

Another preservative treatment for gill nets consists of the following ingredients:

	Pounds
Coal tar	12
Wood tar	6
Kerosene (about 10 gallons)	76
Fine red oxide of copper	6

After the tars are dissolved in the kerosene the sludge is allowed to settle for 24 hours. The clear liquid is then poured off and mixed with the 6 pounds of fine red oxide of copper. The red oxide of copper should be "Navy standard," that is, containing not less than 88 per cent cuprous oxide and fine enough so that 98 per cent can be sieved through a 350-mesh screen. When the net is dipped in this mixture it is essential that the mixture be constantly agitated. To do this it has been found good practice to operate a bilge pump in the center of the kettle or tank, in order to draw the mixture from the bottom of the tank and distribute it over the section of the net being treated.

Another method of preserving gill nets, which is common practice in certain localities, is to wash them in a weak solution of copper sulphate (bluestone). This chemical, while it doubtless acts as a deterrent to bacterial development, can not be regarded as having a very prolonged effect.

TREATMENTS FOR PURSE SEINES

Most purse seines on the Pacific coast of the United States are preserved by tanning. During the fishing season it is the general practice of the fishermen to wash the seines and then dip them in a solution of hemlock extract about once each week. These purse seines are hand knit by the fishermen from twine which has been tanned prior to purchase. On the Atlantic coast of the United States purse seines are generally preserved with light crude coal tar. The deterioration of purse seines, aside from mechanical wear, appears to be due to the breakdown of the twine by heating, caused by the action of bacteria in the slime which clings to the webbing after a haul has been made. Damage from this cause may be lessened by washing the net thoroughly with sea water after each haul and then sprinkling the net with salt at the end of each day's fishing. While in storage, purse seines should be packed in enough salt to cover all parts of the webbing.

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IMPROVED METHODS FOR THE COLLECTION OF SEED OYSTERS[1]

By Herbert F. Prytherch

Assistant Aquatic Biologist, United States Bureau of Fisheries

CONTENTS

INTRODUCTION

In order to devise new methods for maintaining and increasing the supply of oysters, the Bureau of Fisheries has conducted extensive studies and experiments under the direction of Dr. P. S. Galtsoff, in Massachusetts, Connecticut, New York, and various other coastal States. Two practical methods have been developed for increasing the production of seed oysters, since the decrease in the supply of these has been one of the principal causes for the decline of the industry. In the propagation and cultivation of oysters the most important operation is that of collecting the seed oysters, or spat, on some suitable material such as shells, gravel, brush, etc. The usual practice is to clean and prepare an area of bottom in the vicinity of the spawning beds and plant thereon from 500 to 1,000 bushels of oyster shells per acre. The oyster larvæ when fully developed cement themselves or set upon these shells and though designated as set, or spat, are in reality small seed oysters, as they grow and develop into the adult.

The quantity of seed oysters that is obtained on the shells varies greatly according to seasonal conditions, number of spawners, and especially the location of the bottoms on which the shells are planted. In nearly every oyster-growing region there are certain areas or zones where the setting is of greatest intensity, and more seed oysters are produced than can survive and grow on the surface that is available. For example, in some of these areas we oftentimes find on a single oyster shell from a few hundred to several thousand spat while only 25 or 30 of these are able to survive. With such intensive setting, a very high percentage (98 to 99.9 per cent) of the spat die from overcrowding, lack of food, oxygen, etc.; and those surviving are so closely cemented together and misshapen that they are of

[1] Appendix IV to the Report of the U. S. Commissioner of Fisheries for 1930. B. F. Doc. 1076.

little value as seed oysters or as adults. The extensive coon oyster beds in the South Atlantic and Gulf States are outstanding evidence of this fact. The purpose, therefore, in developing these new methods and devices is to reduce this unnecessary loss of seed oysters as much as possible and to obtain the most efficient utilization of these intensive setting areas.

The plan of the experiments was twofold, namely: (1) To increase the amount of surface available in a given area for attachment of the oyster larvæ, which would not only reduce the number of spat per unit of surface and allow more room for growth, but would greatly increase the number of bushels of seed oysters that could be produced on a limited area of bottom; and (2) to find a material to which the larvæ would attach that would be superior to shells, in that it would break apart and allow the spat room for growth when they were a few months old. For example, on 1 square inch of surface of oyster shell an original set of 100 or more spat becomes reduced to approximately 50 in one month, 25 in two months, and finally 1 or 2 at the end of the year. (See fig. 4.) It is obvious, therefore, that a collecting material which would allow separation of spat 1, 2, or 3 months old would prevent death of a large number and produce well-shaped seed oysters.

Two types of seed-oyster collectors which fulfill one or both of the previously outlined requirements have been developed, tested, and applied successfully on a small commercial scale. One type consists of an elongated wire bag, which can be filled with oyster or other shells and planted on the bottom singly or in tiers. The other and latest-developed collector consists of a series of compartments or partitions of waterproof cardboard, resembling an egg-crate filler, which are coated with a mixture of lime, cement, and sand. It will perhaps be convenient in subsequent discussion of the construction and use of these collectors to speak of the first as the wire bag and the second as the partition type.

Though both of these collectors were devised by the author, he is greatly indebted to Capt. Charles E. Wheeler, of the Connecticut Oyster Farms Co., and to W. H. Raye, president of the General Seafoods (Corp.), for their suggestions and improvements. Captain Wheeler supplied the original idea for our first experiments in 1925, in which we used 1-bushel wire baskets, filled with various kinds of shells, on which thousands of spat were collected. The final step in perfecting the partition collectors and making them of practical value is due to the plan of Mr. Raye for using a lime or cementlike coating, which offered an ideal surface for collection of the spat and their subsequent separation into single seed oysters.

The experiments with the different collectors were carried on in several localities in cooperation with the following parties and concerns, to whom the bureau is indebted for supplying materials, men, and boats for this work: Milford Harbor, Conn., C. E. Wheeler, Connecticut Oyster Farms Co.; New Haven Harbor, Conn., F. Mansfield Oyster Co.; East Haven Harbor, Conn., H. W. Beach, Connecticut Shellfish Commission; Branford Harbor, Conn., E. Ball & Co.; Onset Harbor, Mass., Besse & Schroeder Co.; and Great South Bay, Long Island, P. Mercer, Blue Points Co.

WIRE-BAG COLLECTORS

Various types of seed collectors were tested out in Milford Harbor in 1925, the most successful being the round, galvanized-wire bushel baskets which were filled with clam, mussel, and oyster shells. Twelve of these baskets were set out on the tidal flats and collected on the average 15,000 spat per bushel of shells. The spat were not uniformly distributed throughout the baskets but were most numerous on shells in the bottom and on the outside edges and were comparatively scarce on those in the middle. By actual count the oyster shells on the top, bottom, and sides were found to be covered with from 25 to 200 spat, those on the next inside layer with from 12 to 50, while in the center only 2 to 10 spat were found per shell. These initial

FIGURE 1.—Seed oysters collected in wire basket

experiments showed that by placing shells in a comparatively open container we could greatly increase the amount of shells that could be planted on a given area and thus offer more surface for the attachment of the oyster larvæ. Previously the planting of shells was limited to a narrow layer just above the bottom; but by this means it was possible to utilize in a practical way a third dimension, or the vertical distance above the bed. A single basket covering approximately 1 square foot collected more seed oysters than would ordinarily be obtained by a heavy planting or scattering of shells over 1 or more yards of bottom. It was obvious, however, that a change in the shape of this type of shell container should be made that would facilitate the passage of the larvæ among the shells and thus produce more uniform setting. For this purpose triangular lath crates were tested out in 1926 as shell containers, a study of which led to the construction of the wire bags having the proper dimensions for uniform setting.

The wire bags were made of from 1½ to 2 inch mesh chicken wire, which was cut so as to form the walls of a cylindrical container having a length of 36 inches and a diameter of 12 inches. They had a capacity of 1 bushel and were filled with oyster, scallop, clam, or sea scallop shells according to the locality in which they were used. In making the bags the wire in the 24-inch rolls was found to be most suitable and was cut in pieces 4 feet long. Each piece was then folded lengthwise and the ends closed either by twisting the wires together or by weaving a short piece of No. 18 annealed iron wire through them. The bags were then filled with shells and closed tightly by drawing and weaving the open edges together with a piece of the annealed wire. In these cheap containers a large quantity of shells

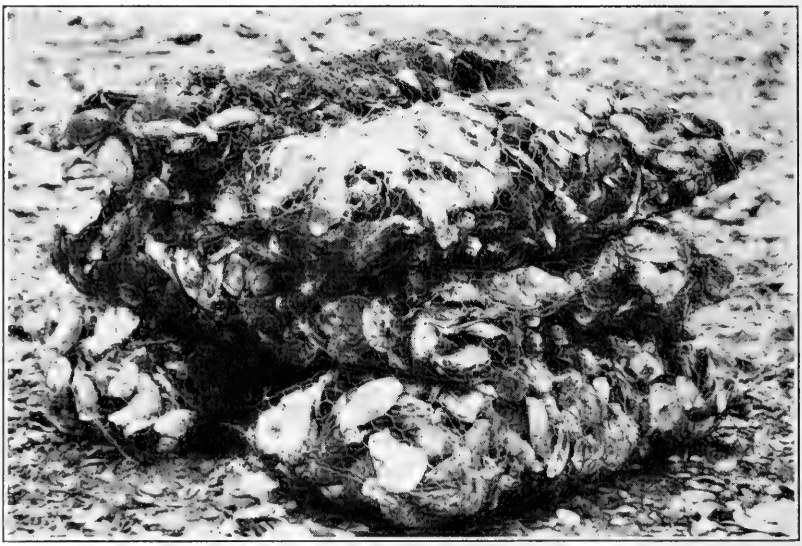

FIGURE 2.—Stacking 6 bushels of shells on 1 square yard of bottom by means of wire bags

can be handled very easily and thrown from wharf to boat and onto the beds without the bags breaking open. The total cost for material and labor in preparing and setting out these collectors amounted to approximately 25 cents per bag. For operations on a large scale the cost of operations could be greatly reduced by using ready-made bags and filling them by one end from a hopper by a method similar to that employed in handling grain.

In 1927 and 1928 the wire-bag method of spat collection was tested on a small commercial scale at Great South Bay, Long Island; New Haven Harbor, East Haven Harbor, Branford Harbor, and Milford Harbor, Conn.; and at Onset, Mass. The experiments in Connecticut and Long Island were carried on by the author, and those in Massachusetts were under the direction of Doctor Galtsoff. In the following tables a brief summary is given of the results that were obtained in these localities.

TABLE 1.—*Results in 1927*

	Milford Harbor	Onset Harbor (Shell Point [1])	Great South Bay
Average number of spat per bag	2,450	5,880	18,000
Maximum number of spat per bag	3,500	12,600	22,000
Minimum number of spat per bag	1,500	2,000	7,500
Average number of spat per shell	9	19	75
Maximum number of spat per shell	50	42	150
Per cent of shells covered with spat	95	90	90

[1] In the zone between low-water mark and 2 feet above it.

NOTE.—This was a very light setting yeai in each one of these regions.

TABLE 2.—*Results in 1928*

	Milford Harbor	Onset Harbor (Shell Point [1])	Other Connecticut harbors
Average number of spat per bag	15,000	39,500	15,000–20,000
Maximum number of spat per bag	26,000	68,600	25,000
Minimum number of spat per bag	9,000	2,320	5,000
Average number of spat per shell	60	131	70
Maximum number of spat per shell	85	229	100
Per cent of shells covered with spat	99	99	90–98

[1] In the zone between 1 foot below low-water mark and 1 foot above it.

NOTE.—In Connecticut the setting was light while in Onset it was fairly heavy.

The number of spat collected in the bags was found to vary according to (1) the intensity of setting in each locality, (2) the location in which they were planted in the harbors, and (3) their position in relation to low water mark and the zone in which setting was heaviest. In comparison with the commercial practice of scattering shells over the bottom, the bags proved to be far superior and collected from 10 to 100 times as many seed oysters on the same area of bottom. When the bags were stacked crosswise in tiers of six or eight to a group, there were produced or collected several hundred thousand seed oysters per square yard of bottom. which were uniformly distributed over 6 or 8 bushels. In Great South Bay, where the settings occur through a vertical distance of approximately 6 feet the planting of the bags in stacks of 10 during the good setting years would not only yield over 500,000 seed oysters per square yard of bottom but would also keep a large number of them alive and allow better growth. In the past these heavy sets have been so densely packed in a thin bottom layer of shells that practically all have died from overcrowding and lack of nourishment.

Although the wire bags will serve to increase the production of seed oysters there will still be a considerable loss because the supply of shells is limited and only a small number of spat can survive from sets of 100 or more per shell. The best solution of this problem, thus, calls for a collector that is (1) cheap, practicable, and suitable for stacking; (2) capable of manufacture in large quantities; and (3) suitable for collecting spat and especially for their separation soon after attachment. A device that satisfies these requirements is the partition type of seed collector.

EXPERIMENTS WITH PARTITIONS

The first collectors of this type were devised by the author in 1923 (Bureau of Fisheries Document No. 961) for the purpose of facilitating the handling of heavy oyster sets and reducing to a minimum the loss of seed oysters from overcrowding. They were made from ordinary egg-crate partitions which were dipped in hot paraffin and then coated with a layer of coarse sand. The setting in Milford Harbor during that summer was comparatively light and an average of only two or three spat per square inch was obtained on the partitions. These experiments showed, however, that these cheap collectors were capable of collecting thousands of spat and that in two or three months they would break up so as to produce single seed oysters. The partitions quickly sank to the bottom and were heavy enough to withstand tides and storms in a moderate depth of water.

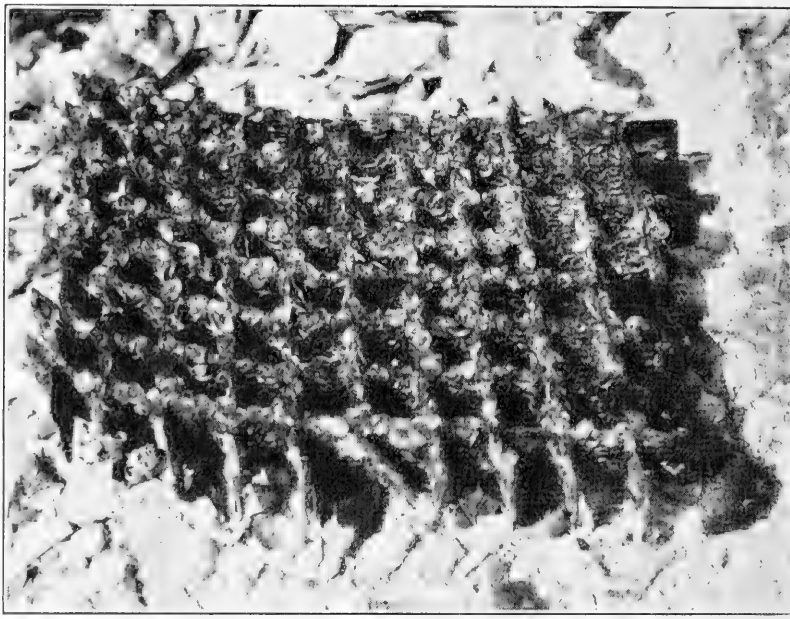

FIGURE 3.—Partition collector covered with 15,000 spat 2 months old. Great South Bay, Long Island, 1929

Experiments along this line were temporarily discontinued until 1927 and 1928 when partitions coated with tar and asphalt were used, as spat had often been found growing on such materials when applied to boats, fish nets, etc. These collectors likewise obtained a set which, unfortunately, was very light for both years so that the real value of the partition for handling heavy sets could hardly be demonstrated. If such partitions had been placed in Great South Bay in 1929, it is very likely that they would have been equal to those coated with lime and cement for collecting and growing the heavy set that occurred there.

The partitions that were used in Milford Harbor and Great South Bay during the past summer were made of 22 interlocking strips of waterproof cardboard 15 inches long, $1\frac{1}{2}$ inches wide, and $\frac{1}{25}$ of an inch thick. A single assembled partition collector consists of 100 inner closed compartments surrounded by a row of 44 partially inclosed spaces, giving a total collecting surface of approximately 1,000 square inches.

In Great South Bay 1,000 partitions were tested out by the Bluepoints Co., and the Connecticut Oyster Farms Co. tested 1,000 in Milford Harbor. The partitions were coated by quickly dipping them into a vat containing a mixture of quicklime, sand, and cement mixed with either fresh or sea water to a consistency of thick cream. After being allowed to drain, they were set aside for several days until thoroughly dry. The mixtures used varied from a proportion of 2 parts quicklime, 2 parts cement, and 1 part fine sand to 1 part hydraulic or Portland cement, 1 part quicklime and 2 to 4 parts ordinary beach sand. The coating should preferably be one-thirty-second of an inch or less in thickness and of sufficient hardness and strength as to make the partitions rigid enough for stacking and handling. For the collectors that were planted in Great South Bay in 8 feet of water, a coating of equal parts cement, quicklime, and sand, approximately one-thirty-second of an inch thick, was found very satisfactory. For the ones that were planted in Connecticut on tidal flats and exposed to wave action, the coating was made slightly heavier and harder by using more cement in the mixture. The most uniform coating was obtained by dipping the partitions twice in a more watery mixture so as to give them two very thin coats, the second of which was applied after the first had set but was still moist.

The real value of the partitions as seed collectors depends largely upon obtaining a thin, shell-like coating that will either disintegrate as the spat grow or that will allow their separation from the partitions when the set is shifted to growing grounds. In Great South Bay the partitions were thrown overboard into water 6 to 8 feet deep, where they settled immediately over a previously planted layer of oyster shells. The shells served to hold the partitions a short distance above the bottom, allowing the water to circulate through them and preventing the accumulation of sediment within the compartments. In a few cases where the partitions fell on hard mud bottom the growth and survival of spat on the lower half of the collector were considerably reduced by deposition of sediment and lack of water circulation. On the lower portion of these, the spat attained an average size or diameter of only one-eighth of an inch in two months, while those on the upper edges reached a length of over half an inch. This same condition is found in spat collected on shells in this region, the ones on the lower side and edges growing very little and eventually dying, while those one-half inch or more above the bottom grow very rapidly.

An examination of the partitions during the early part of July showed the attachment of a fairly uniform and heavy set ranging from approximately 100 to 200 spat per square inch. The growth and survival of these spat were essentially the same as that given in the following figure which is based on a study of the heavy set in Milford Harbor in 1925. The curves show clearly the competition between the spat in growth and survival that results in a loss of over 99 per cent at the end of a year. The rate of mortality is unusually high during the first, second, and third months and results primarily from overcrowding. Representative collectors taken from different parts of the bay in September yielded by actual count 10,000 to 25,000 single seed oysters per partition. A week after the time of setting, however, each partition was covered with as high as 100,000 to 200,000 spat, large numbers of which were gradually covered over and smothered by the more rapidly growing individuals. In the lower valves of the larger surviving spat there were oftentimes found

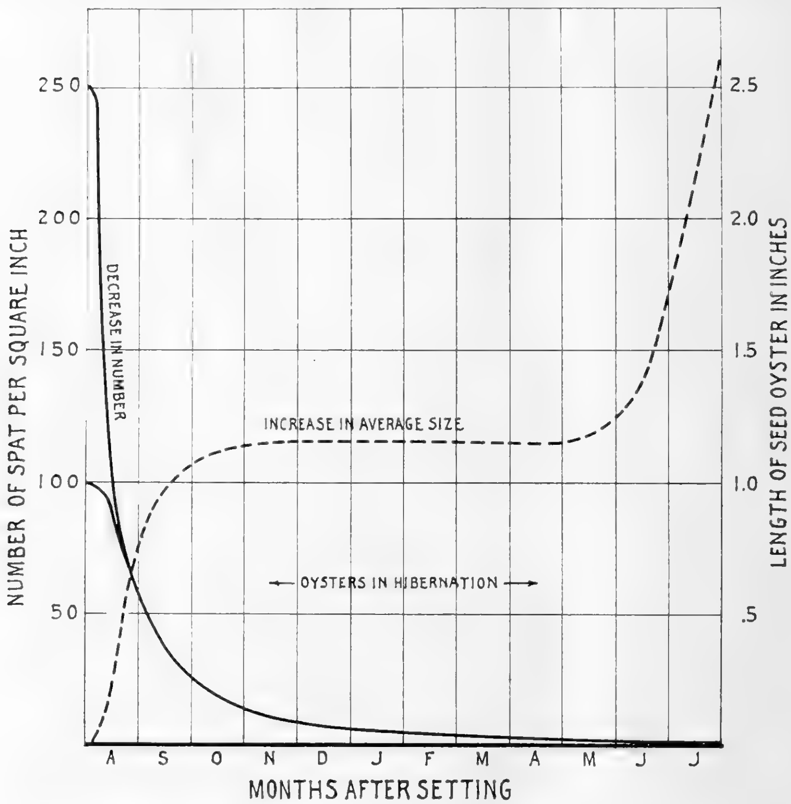

FIGURE 4.—Growth and survival of spat on oyster shells, Milford Harbor, 1925–26

embedded many shells of the smaller individuals which they had overgrown. By the first week in September the spat had attained an average length of one-half to three-fourths inch and were somewhat elongated in shape as a result of crowding. At this age and size the concentration of spat on the partitions ranged from 15 to 30 per square inch. At a concentration of 20 or less it was found that each individual spat was fairly well shaped and had developed sufficient thickness of shell to withstand detachment and separation from the collector and surrounding spat. At concentrations of over 20 per square inch, the spat were decidedly overcrowded, the shells thin, greatly distorted, and so closely ingrown with those adjoining as to make detachment without injury a difficult matter. It thus appears that a set of less than 20 spat per square inch would be the concentration most desirable on collectors from which they are to be detached in approximately two months. The only practical method of limiting the intensity of setting under such conditions is by stacking of shells or partitions so as to offer more surface for attachment of the oyster larvæ.

The detachment of spat from the South Bay collectors was in some instances automatically brought about by disintegration of the collectors, but in most cases required hand labor. The partitions were broken up by tearing apart each cardboard strip, by hitting the collectors against some solid object, or by slipping a broad, sharp knife under the spat or cement. The loss of spat from these operations ranged from approximately 2 to 5 per cent and depended largely upon the concentration per square inch. Spat which are growing vertically to the surface of the partition can be separated easily with minimum loss. Those that are lying flat are difficult to detach without injury and should be planted by tearing the partition into squares at each joint. Though the present methods of spat detachment and separation are comparatively crude, they do demonstrate that seed oysters can be successfully removed from such collectors when a few months old. During the coming summer further experiments will be made to improve the size, shape, and coating of the partitions and determine the most desirable specifications for use in accordance with conditions in different localities.

In Milford Harbor the partitions were either set out directly on hard bottom or shells or were elevated a few inches in groups of four by means of stakes. A very light set occurred the first week of August, ranging from 75 to 200 spat per collector, followed by a greatly delayed heavier set on September 14 to 18, of approximately 1,000 to 2,000 spat per collector. Because of the slow growth and lateness of this set very few observations or conclusions on these experiments can be made until next spring. A few dozen partitions were coated with hot asphalt to which small bits of oyster shell were made to adhere, and these were found to have collected nearly as many spat as the cement-coated type.

It might be well to point out here another advantage in obtaining separation of the seed oysters when a few months old as demonstrated by experiments in Milford Harbor in 1928 and 1929. A set averaging 60 spat per shell was obtained on new oyster shells and also on old, thin, fragile shells that were excavated from deposits in the Housatonic River. A year later the new shells were covered with 20 to 25 closely crowded seed oysters, while those on the old shells had broken apart and were lying about singly on the bottom. By measuring the displacement of several representative samples it was found that 25 of the single seed had a total volume in one year of 14.5 cubic inches while the same number when crowded on a shell had a volume of only 7.8 cubic inches. In other words, there is nearly 100 per cent increase in volume and growth to be gained during the first year by the early separation of seed. The shell which they produce is also much thicker, much heavier, and nearly round in shape and will withstand rough treatment in dredging and transplanting operations.

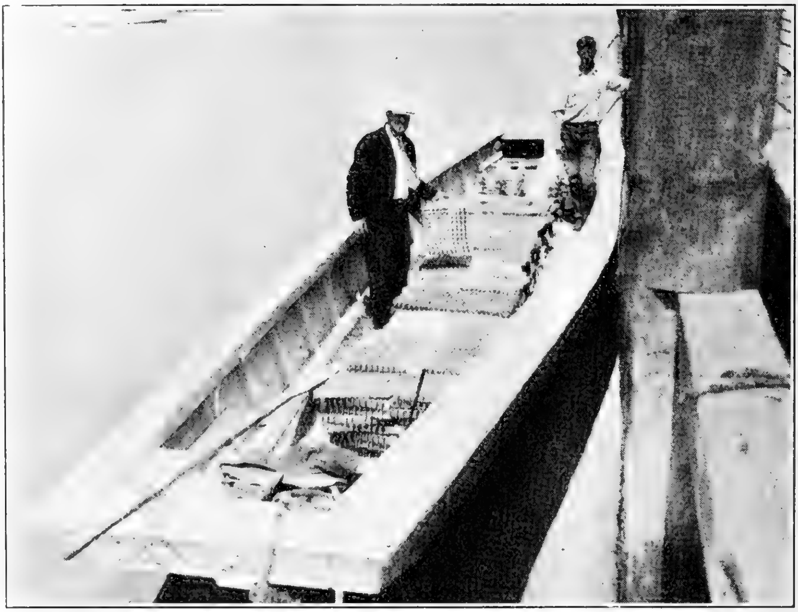

FIGURE 5.—Partition collectors ready to be planted

FIGURE 6.—Planting of partitions in Milford Harbor, Conn.

Since oyster shells are used more extensively than any other material for collecting set it will be well to compare them in many respects with partitions in order to show whether the latter are really of practical value. One bushel of shells offers a surface of approximately 5,000 square inches but at least half of this is lost when the shells lie on the bottom and sediment settles upon them. One partition has a surface of 1,000 square inches, all of which remains clean because it lies vertical to the bottom. Two partitions are approximately equivalent to 1 bushel of shells in collecting surface, and each has obtained, we shall say, a set of 10 to 20 spat per square inch. By fall the crop of seed on each will be about equal except that those on the partitions will be slightly larger as a result of being elevated above the bottom. When the seed is dredged and shifted at an age of 2 to 3 months the loss of spat on the shells will be approximately 2 to 5 per cent and about equal to that in separating the seed from the partitions. Each material now has about 30,000 spat, but the number on the shells decreases rapidly to 10,000 in six months and finally to approximately 3,000 in one year as a result of overcrowding. The extent of loss in seed taken from the partitions will depend upon the skill used in detaching them and especially upon the selection of clean hard bottom for their subsequent growth. In a year we should have 20,000 to 25,000 single seed oysters from the partitions as against a crop of 3,000 crowded individuals on shells.

DISCUSSION AND SUMMARY

The previous experiments have dealt with the problems of collecting heavy oyster sets by the use of practical and efficient methods. To increase the production of seed oysters in intensive setting regions such operations and devices must be employed as will reduce crowding of the spat to a minimum. In order to prevent the loss of over 90 per cent of the spat by this cause, the setting must either be distributed over a greater amount of surface or the spat must be separated from each other, preferably when they are 1 or 2 months old. The oyster culturists clearly recognize that a well-distributed light set of 10, or even 1 spat per square inch, is oftentimes more valuable and productive of better seed oysters than are heavy sets. The fact nevertheless remains that each small spat produced by a heavy set is potentially equal to those from a light set, and the oyster farmer, through inadequate methods, has permitted the loss of this valuable product that would soon amount to millions of bushels of seed oysters. This state of affairs has existed chiefly as the result of four conditions, namely: (1) An insufficient supply of shells, (2) a limited area of good setting bottoms, (3) ineffectiveness of heavy shell plantings, and (4) the yearly fluctuation in setting on any particular area. The research and practical experiments conducted by the bureau during the past few years have served to furnish a solution to these problems and to remove certain limitations.

The supply of a suitable set-collecting material can now be increased to meet any future demands by preparation during the winter, of lime, cement, tar, or asphalt coated partitions. The production of limited setting areas can be increased by the use of the wire bag or partition type of seed collectors which make available

FIGURE 7.—Heavy set on oyster shell planted in Great South Bay. Enlarged portion of this shell shown in Figure 9

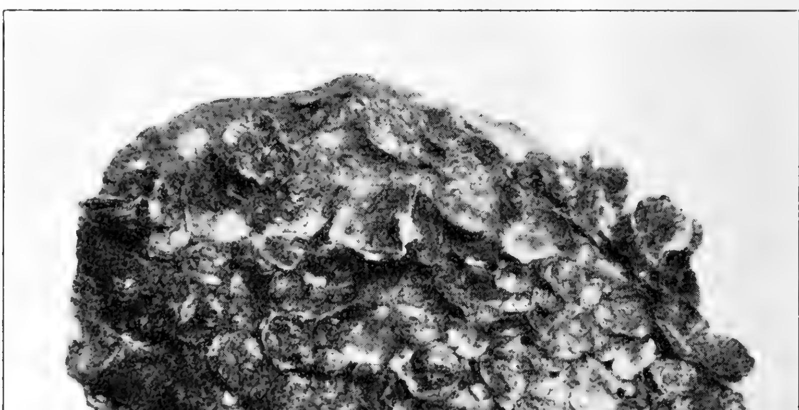

FIGURE 8.—Heavy set two months later. Spat dying from overcrowding and unfavorable bottom conditions

the collection of set through the whole vertical range or zone in which setting takes place.

The intensity of setting that will occur each year in certain localities can be determined a month or more in advance by the method outlined by the author in Bureau of Fisheries Document No. 1054. When the outlook is unfavorable the collectors can either be planted sparingly or be saved until the following year. When conditions

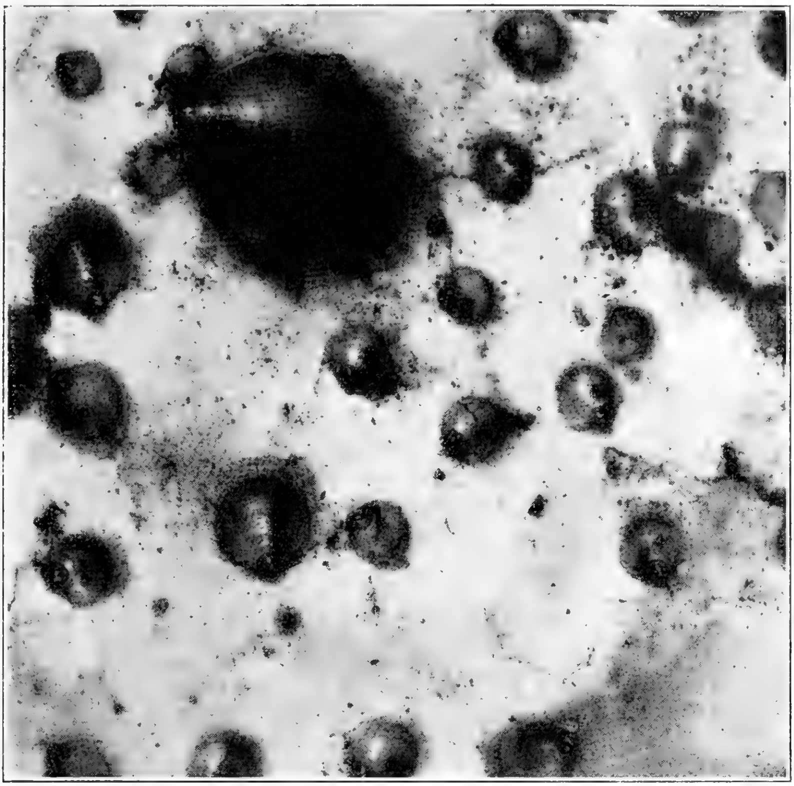

FIGURE 9.—Enlarged photograph of ½-inch square of oyster shell, showing 28 spat 1 week old, and only 1 of which can survive at the end of the year

are favorable, planting operations can be increased so as to prepare as great an amount of surface as possible for collection of spat. By obtaining the maximum yield during the best setting years the industry will be benefited not only by having more and better seed to grow for market but by having in the coming summers a good supply of oysters for the production of spawn and future sets.

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OYSTER INVESTIGATIONS IN GEORGIA [1]

By Paul S. Galtsoff, Ph. D., *In charge of Oyster Fishery Investigations*, and R. H. Luce, Ph. D., *Temporary Assistant*

CONTENTS

INTRODUCTION

In 1925, in compliance with the request of the Department of Game and Fish of the State of Georgia, an examination of the oyster beds of this State was undertaken to ascertain what practical measures were necessary to restore the natural oyster beds and to increase the production of oysters in the State. The investigation was carried out with the cooperation of the State game and fish commissioner. In February and March, 1925, the senior author with the State survey boat *Two Friends* covered 351 miles between Savannah and St. Marys, Ga., visiting the following localities: Wilmington River, Tybee River, Lazaretto Creek, Oyster Creek, Shad River, Skidaway River, Back River (Burnside Island), Vernon River, Ossabaw Sound, Bradley River, Florida Passage, Kilkenny Creek, Cabbage Creek, Bear River, Newell Creek, St. Catherine Sound, Walburg Creek, Cedar Creek, Sunbury Creek, Ashville Creek, Little Ashville Creek, Timmons River, Johnson Creek, Sapelo Sound, Blackbeard River, Mud River, Old Teakettle Creek, Doboy Sound, Connegan River, Dead River, Folly River, Buzzard Roost Creek, North River, Back River, South River, Rockdedundy River, Wolf Creek, Altamaha Sound, Frederic River, St. Simon

[1] Appendix V to the Report of the U. S. Commissioner of Fisheries for 1930. B. F. Doc. 1077.

Sound, Turtle River, Jekyl Creek, St. Andrew Sound, Cumberland River, Brickhill River, Cumberland Sound, and St. Marys River.

The program of observations consisted of examination of the bottoms and determinations of temperature, salinity, hydrogen-ion concentration of the water, and of the amount of material suspended in it. The results of the survey served as a basis for outlining a series of recommendations concerning the management and development of the natural oyster reefs. In order to obtain a better understanding of the local conditions affecting the life of the oyster, it was deemed desirable to extend observations throughout the spawning and setting season. In the summer of 1928 Dr. J. H. Weatherby, temporary assistant, was assigned to field work in the vicinity of Doboy Island. Under the supervision of the senior author and in cooperation with the State department of game and fish he carried out a program of observations and made experiments on spawning and setting of oysters. In April, 1929, Dr. R. H. Luce visited Doboy Island to examine the spat collectors which were placed there during the preceding summer and to make some additional observations on tidal currents.

It is the authors' desire to acknowledge the cooperation of the State department of game and fish and to express their gratitude to Peter S. Twitty, commissioner, and R. W. Clancy and J. F. Seegers, tidewater commissioners, for help and interest in this work.

PHYSIOGRAPHY OF THE COASTAL REGION

The oyster-producing bottoms of Georgia are entirely confined to the coastal region, which consists of numerous sounds, estuaries, and of a network of tortuous rivers and creeks connecting with each other and surrounding low and uninhabitable marshlands. Due to recent (from the geological point of view) submergence of the coastal lowland, the mouths of the large rivers have been converted into estuaries navigable by seagoing vessels from 10 to 20 miles from the seacoast, while small creeks became deep tidal rivers. Owing to the low altitude of the land, the streams are sluggish and the whole coastal plain poorly drained. One of the most typical characteristics of this region is the salt marshes, which reach their greatest extent near the mouths of large rivers. The origin of the marshland, according to O. Veatch and L. W. Stephenson (1911), is attributed to the submergence of the coast, although silting is also considered as a contributing factor. The whole area of the inshore waters of Georgia can be characterized by its comparative shallowness; continuous deposition of sediment, which settles as a thick layer of soft mud on the bottoms and over the tidal flats; and strong tidal currents sweeping the tidal rivers and creeks. From an ecological point of view, the waters of this region may be divided into three classes, as follows: (*a*) Open sounds, (*b*) rivers, (*c*) small creeks and marshes.

OPEN SOUNDS

[St. Andrews, St. Simon, Altamaha, Doboy, Sapelo, St. Catherine, Ossabaw, Wassaw. See figs. 1 and 2]

The sounds are large bodies of water varying from 1 to 2 miles in width at their mouths and extending several miles inland. On their eastern sides they are directly connected with the ocean, although the entrances to the sounds are always obstructed with sand bars. With the exception of the dredged channels, the sounds for the most part are shallow. The character of the bottom varies in different localities, but is generally shifting sand. The salinity of water is rather high near the entrances, gradually decreasing toward the mouths of the rivers. The sounds are exposed to heavy northeast seas from the ocean.

RIVERS

[St. Marys, Satilla, Altamaha, Darien, Ogeechee, Savannah. See figs. 1 and 2]

On the basis of their origin, rivers of the State of Georgia emptying into the Atlantic Ocean fall into two classes: Those originating in the Piedmont Plateau and Appalachian Mountains, such as the Savannah, Ogeechee, and Altamaha Rivers; and those having their source within the coastal plain, such as Satilla and St. Marys. The rivers of the first class have larger drainage areas, are longer, and carry greater volumes of water. With the exception of the Ogeechee River, which throughout a greater part of its course has much the aspect of a stream of the second class, their waters are muddy, containing a considerable amount of sediment derived from red clay hills of the Piedmont Plateau. The rivers of the second class are smaller; they flow wholly through areas where the geological formations are predominantly sand, and, therefore, their waters are clear but dark, or even black, from dissolved organic matter.

The bottoms of the rivers vary greatly, ranging from very soft mud to hard mud and shifting sand. The water near the mouths is always brackish but subject to great fluctuations, depending on the stage of the river and tide. At the time of freshets such as occurred in January and February, 1925, entirely fresh water was found as far as the clubhouse near the entrance of Altamaha Sound. On the other hand, at low stage during the dry season the salinity increases, approaching the degree characteristic of the open ocean. Tidal currents are strong in the rivers and reach a velocity of several knots at ebb tide.

MARSHES AND CREEKS

A continuous network of small creeks, tidal rivers, estuaries, and salt marshes is a characteristic feature of the coast. The area of salt marshes probably does not aggregate more than 150 or 200 square miles; but since no survey of the marshland of the State has yet been made, accurate figures are not available. The character of the bottom represents all the graduations from extremely soft mud to hard mud and clay, while sand occurs here very rarely. The bottom is often covered with pieces of marsh grass mixed with either clay or mud, making a relatively hard substratum. The salinity of the water varies in different localities, but its fluctuations are not as great as in the mouths of the large rivers. The tides, that create strong currents in the sounds and rivers, flow rather slowly in the creeks and marshes but provide an exchange of water sufficient to prevent stagnation.

DISTRIBUTION OF NATURAL OYSTER BEDS

The natural oyster beds in Georgia were carefully examined by J. C. Drake in 1889, and the results of his survey were published in United States Coast and Geodetic Survey Bulletin No. 19 (1891). The location of oyster beds described by Drake is shown in the sketch charts (figs. 1 and 2), which were prepared from the charts published by the United States Coast and Geodetic Survey (1891). A survey made in 1925 has shown that there are no significant changes in the distribution and extent of the natural oyster beds, although a difference in their condition was very noticeable. Many areas indicated in the old survey as natural oyster beds include, at present, all those areas where oysters had grown. In many instances, nothing but shells now remain; in others, the shells are even covered by a layer of silt.

FIGURE 3.—First stage of the formation of an oyster bed. Soft mud flats near Brunswick, Ga. Low tide

A glance at Figures 1 and 2 discloses that most of the natural beds in Georgia are located along the shores of the rivers and creeks, where they form long and narrow strips on the flats. Most of these beds are confined to the zone between high and low tidal marks. There are but a few localities where oysters are found growing on the bottom of the streams. Scattered single oysters can be found also in small creeks and in the marshes where bottom is sufficiently firm to support their weight. It is interesting to note that although oysters thrown on the bottom below low-water mark will grow well, no large accumulations of them are found anywhere in Georgia coastal waters except on tidal flats. The peculiar distribution of natural beds apparently is due to the tendency of the oyster larvæ to congregate at the time of setting at the level between high and low water marks. Although, as a rule, tidal flats in Georgia are covered with very soft mud, yet they may contain certain solid objects, as for instance branches or stumps of fallen trees, old shells, etc., to which the larvæ can attach themselves. As a matter of fact, any object thrown on the flats a little above low-water mark and

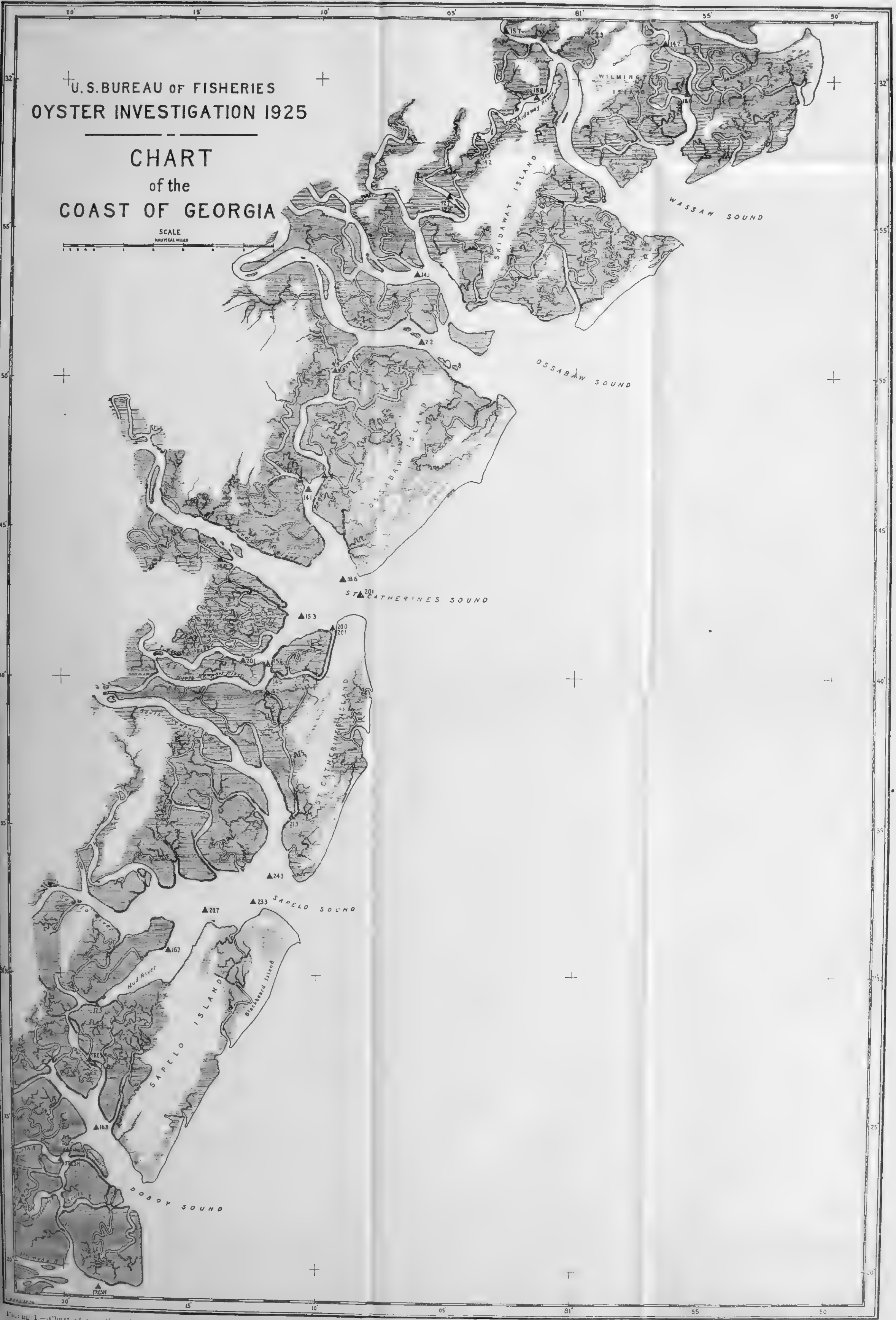

FIGURE 1.—Chart of a section of the coast of Georgia. General location of natural oyster beds is indicated by heavy lines. Stations made February 4 to 16, 1925, are indicated by circles; stations made February 28 to March 13, 1925, are indicated by triangles. Figures beside station marks are salinities in parts per mille at the surface (upper figures) and at the bottom (lower figures)

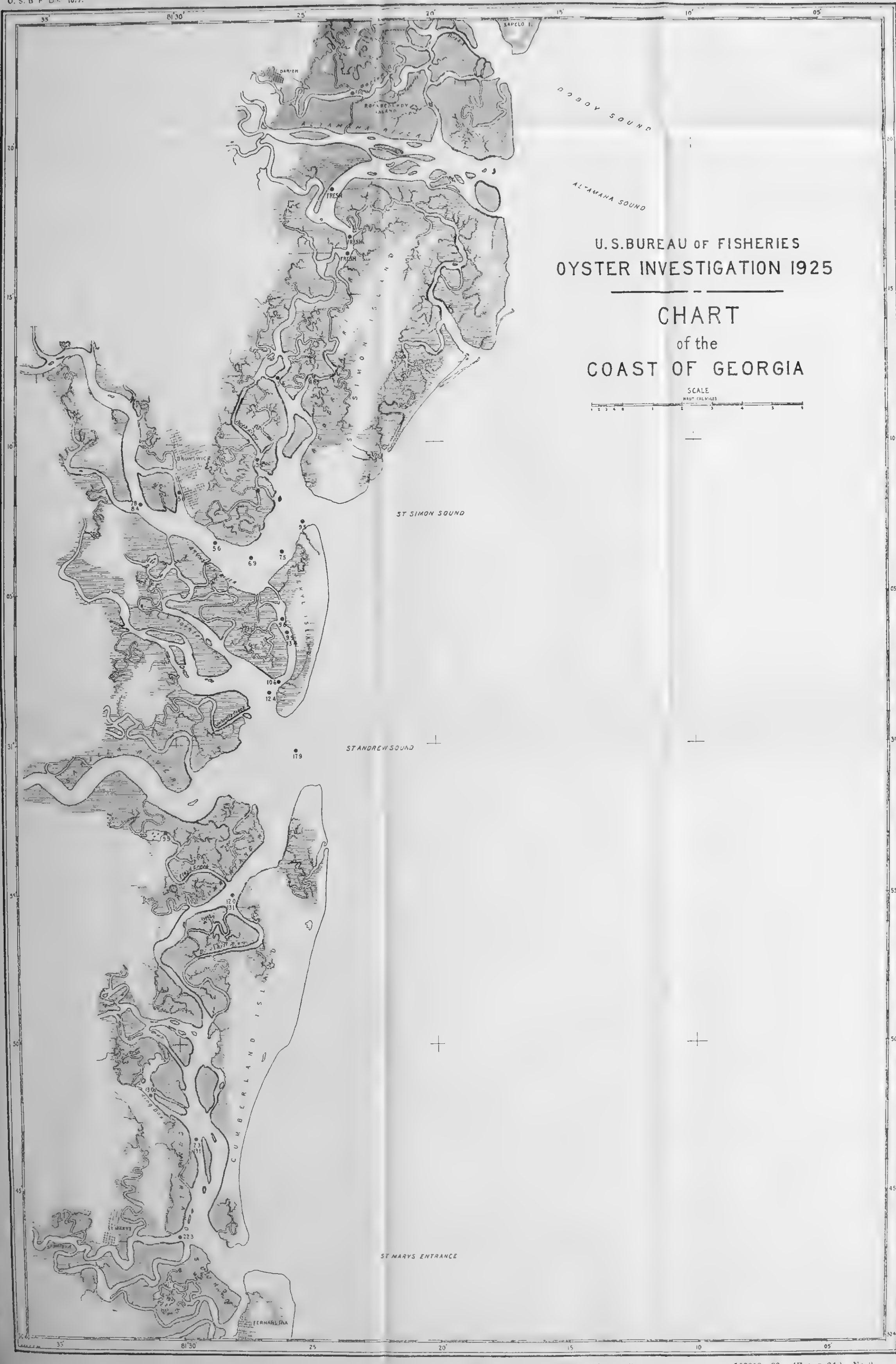

FIGURE 2.—Chart of a section of the coast of Georgia. See legend of Figure 1 for details

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which, on account of its weight and shape, does not sink in the mud, may become a nucleus of a new oyster bed. Oyster larvæ attach to it and begin to grow; young oysters in turn give support to the following generations, with the result that oysters pile one on top of another, forming heavy clusters. Under the weight of it the first ones gradually sink in the mud and perish. When the cluster is broken by the oystermen or by the action of waves and the shells are scattered, they form new nuclei for the development of the bed which grows along the tidal flat and convert it gradually into a continuous and densely populated oyster community. Various

FIGURE 4.—Oysters growing on the stump of a fallen tree. Blackbeard River, Ga. Low tide

stages of the development of an oyster bed can be seen in photographs taken in Georgia waters. (Figs. 3, 4, 5, and 6.)

One of the interesting peculiarities of oysters living on soft mud is their tendency to grow vertically. (Fig. 7.) Single live oysters thrown on the mud and left lying on their sides in about three or four weeks are found standing up vertically, with the anterior (hinge) end buried in the mud and the very sharp posterior edges of the shell (bills) just above the mud. The turning of the oyster is apparently due to the gradual sinking of the heavier and narrow hinge end; the process is facilitated by slight vibrations of the surrounding soft medium caused by vigorous closing of the valves. Keeping itself above the mud and silt, the oyster begins to grow in length and develops into a long, sharp-edged specimen, which is known as "coon" oyster.

Two main factors are responsible for the development of this form: The softness of the bottom and the crowded conditions caused by the lack of material suitable for the attachment of the larvæ. The

" coon " oyster is not a geographical race or a mutation but is merely the result of the growth of the organism under peculiar environ-

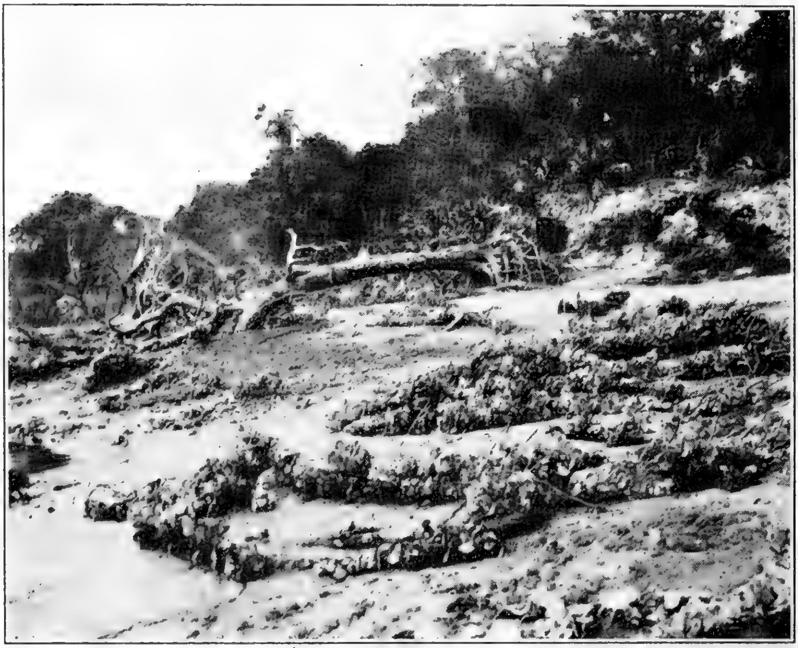

FIGURE 5.—Oysters growing on fallen branches on the shore of the Blackbeard River, Ga. Low tide

mental conditions. It is worth mentioning that in the old times " coon " oysters, which at present may be regarded as the prevailing type of oyster in the waters of South Carolina and Georgia, existed

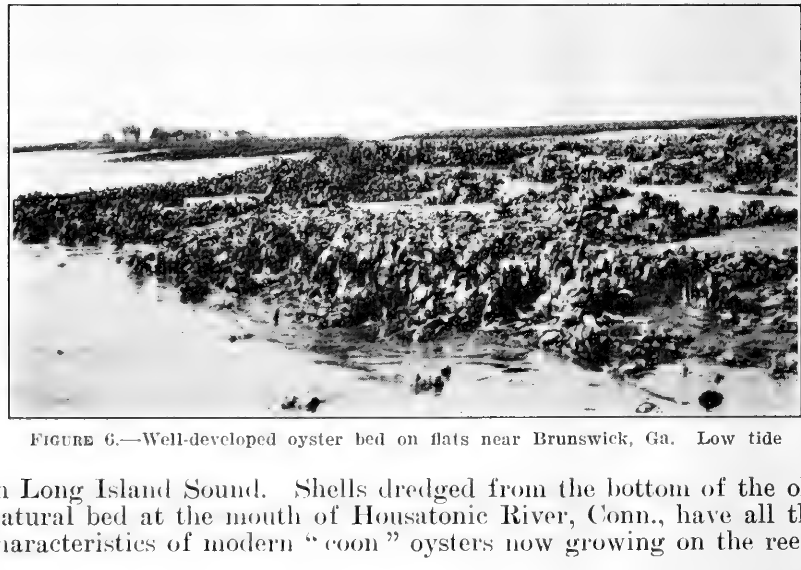

FIGURE 6.—Well-developed oyster bed on flats near Brunswick, Ga. Low tide

in Long Island Sound. Shells dredged from the bottom of the old natural bed at the mouth of Housatonic River, Conn., have all the characteristics of modern " coon " oysters now growing on the reefs of South Atlantic States. It has been demonstrated by Coker (1907) that "coon" oysters broken apart and planted on firm bottom change their form and develop into good-shaped single oysters.

In the zone where setting is very heavy and in the localities where the setting season extends over a period of several months, the accumulation of young oysters attached to a single solid object is so great that it results in the formation of large clusters (fig. 8), sometimes comprising several hundred specimens. It is obvious that small oysters in the middle of the cluster develop under very adverse conditions preventing their normal growth; they never reach marketable size. In 1927, the senior author had a chance to examine oysters taken from the beds in the vicinity of Sapelo Sound and delivered to one of the canneries. The stock was so poor that on the average

FIGURE 7.—Oysters growing on very soft mud. Near Brunswick, Ga. Low tide

there were to every shucked oyster at least 10 oysters which were thrown away unopened because of their small size. There were many clusters comprising from 50 to 75 oysters out of which only 1 was taken by the shucker. One can easily see how this wasteful method leads to the destruction of the natural resource and imposes unnecessary additional expenses in the gathering, transporting, and shucking of oysters.

Besides natural oyster beds located along the shore line and rarely extending below low-water mark, there occur in the open sounds of Georgia large accumulations of oysters forming bars or reefs. The largest reef was found in Altamaha Sound, east of Little Egg Island. (Fig. 9.) The reef, irregular in shape, is about 380 yards long and 75 yards wide. It is built on hard sand, is from 6 to 7 feet high, and is entirely exposed at low tide. An examination of the sides of the reef shows that it is built of a large number of units or "pillars," comprising from 12 to 18 oysters set one on top of another. (Fig. 10.)

All the oysters forming a "pillar" are very long and narrow. The lowest one, which supports the whole column, is partially embedded in sand; its hinge end is very narrow and beak-shaped. Live oysters

FIGURE 8.—Cluster of coon oysters from Bear River, Ga. Actual size, 20.3 by 16.5 centimeters (8 by 6.5 inches)

are found along the sides and on the top of the reef, the interior of the entire mass consisting of dead shells. Few mussels were found attached to oyster shells; they play but an insignificant rôle in the formation of the reef.

From a commercial point of view, reef oysters are of little value, being small and generally poor, but a large accumulation of them on the reef should be regarded as a valuable natural stock of spawners supplying great numbers of oyster larvæ and spat for the whole vicinity.

The origin of the reef is probably similar to the origin of the oyster beds on tidal flats. As soon as a few oysters have established themselves on some solid object on the bottom of the sound, they begin to grow, and in a short time the shells of young oysters in turn begin to offer places for the attachment of new generations. With the growth of the reef the chance for the oyster larvæ to find a place

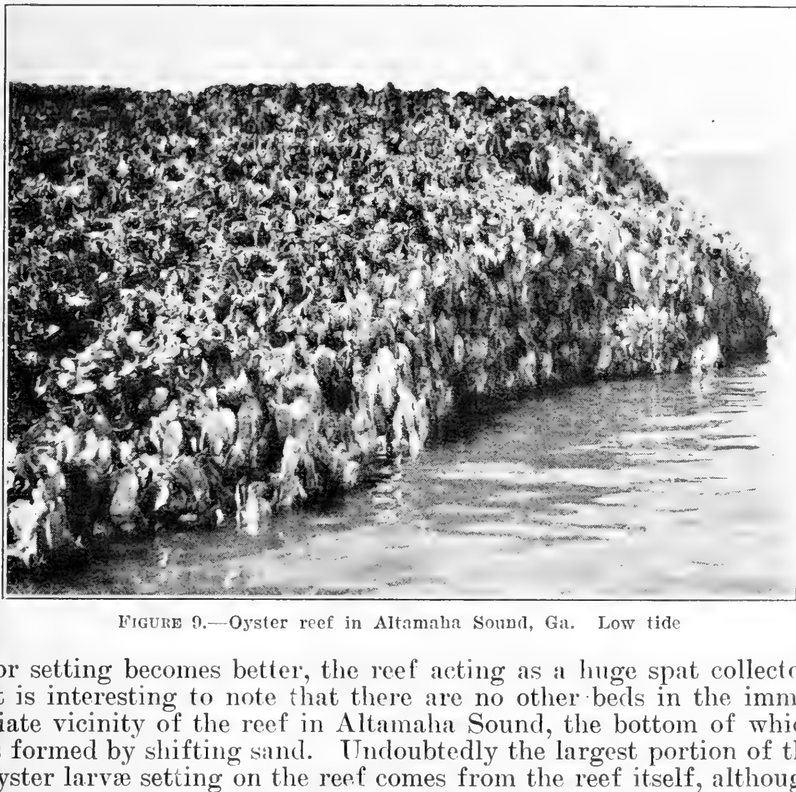

FIGURE 9.—Oyster reef in Altamaha Sound, Ga. Low tide

for setting becomes better, the reef acting as a huge spat collector. It is interesting to note that there are no other beds in the immediate vicinity of the reef in Altamaha Sound, the bottom of which is formed by shifting sand. Undoubtedly the largest portion of the oyster larvæ setting on the reef comes from the reef itself, although a certain number of them may be brought in by the ebb currents from the beds located in the small creeks emptying into the sound.

SALINITY, pH, AMOUNT OF SUSPENDED MATTER IN WATER, AND CHARACTER OF THE BOTTOM

For the successful cultivation of oysters a knowledge of the salinity of water, of its hydrogen-ion concentration, of the amount of suspended matter, and of the character of the bottom is of great

FIGURE 10.—Oysters forming a "pillar" or a unit of construction of the reef shown in Figure 9. Actual length, 46.5 centimeters (18¼ inches)

importance. Each of these factors affecting the life of the oyster may determine the suitability of a given body of water for oyster farming. Excepting the character of the bottom, which in most cases is not subject to sudden and wide changes, all the other above-mentioned factors in the tidewater region are unstable and fluctuate very widely.

It is impossible, therefore, to regard the data collected during a limited period of time as representing average or normal conditions of a given region. While such a view would be permissible in the case of an open sea or landlocked body of water where no significant seasonal changes in the chemical composition of the sea water could be expected, it would be misleading to apply it to the case of a coastal region, which is greatly affected by the stages of the rivers, and where the sea water can be replaced for a varying period of time by fresh water. Hence, we can not speak about normal conditions in a region where wide fluctuations are the rule rather than the exception. On the other hand, a knowledge of the possible limits of fluctuations in physical and chemical changes in the water may have an important bearing on practical problems of the oyster industry. It seemed desirable, therefore, to give in this paper the results of the observations carried out in February and March, 1925. They were made just after a heavy flood which inundated the whole coast of Georgia, and consequently they should be looked upon as representing conditions which occur from time to time on that section of the coast. Observations were carried out between February 4 and 16 and from February 28 until March 13. During the latter time, the flood subsided and the stages of the rivers were nearly normal. The results of the observations are presented in Table 1; the salinity readings are shown also in Figures 1 and 2 beside the circles and triangles which indicate the stations made during the survey. (All the stations made between February 4 and 16 (flood conditions) are shown in circles; those made during the second part of the survey, February 28 to March 13, are shown in triangles.)

TABLE 1.—*Survey of Georgia coastal waters, February–March, 1925*

Stations	Date	Time	Depth (meters)	Temperature, °C.	Salinity (parts per 1,000)	Transparency (feet)	Suspended matter (mg. per liter)	pH
Darien River near Rockdendy T.	Feb. 4	2–4 p. m.	0	11.3	Fresh.	0.5	149.6	5.8
Do.			6	11.6	Fresh.		103.7	5.8
North River, opposite Doboy Island.	Feb. 4	5–6 p. m.	0	11.6	Fresh.	.5	115.3	6.4
Do.			4		5.73			7.0
			7.5	11.4	16.51		31.0	8.0
Altamaha Sound north of Egg Island.	Feb. 5	11.40 a. m.	0	10.3	Fresh.	.2	101.0	6.5
Do.		12.15 p. m.	5	10.1	Fresh.		61.8	6.0
Head of Frederick River	Feb. 5	6 p. m.	0	10.4	Fresh.	.2	59.3	6.0
Do.			6	10.5	Fresh.			6.1
Frederick River	Feb. 6	8 a. m.	0	11.9	4.85			
St. Simon Sound:								
Buoy No. 15	do	11 a. m.	0	11.8	6.08		24.0	
Buoy No. 16	do	11.10 a. m.	0	12.0	9.54		(1)	
Buoy No. 18	do	11.30 a. m.	0	12.6	7.54			
Brunswick Harbor:								
Buoy No. 20	do	11.45 a. m.	0	12.0	6.92			
Opposite quarantine	do	12.05 p. m.	0	12.2	5.64			
City dock	do	6 p. m.	0	12.2	5.59			
Do.	Feb. 7	8.10 a. m.	0	12.4	5.64			
Opposite quarantine	do	2 p. m.	0	13.4	7.38			
Turtle River	do	8 a. m.	0	12.1	7.02		23.7	7.3
Opposite Brunswick buoy No. 2.			10	11.9	8.44	2.5	158.0	7.3
Jekyl Creek	Feb. 7	11 a. m.	0	14.3	9.9	1.33	169.3	7.5
Do.			4	13.7	13.4			7.6
St. Simon Sound (opposite entrance to Jekyl Creek).	Feb. 9	10.20 a. m.	0	14.3	12.39			
Mouth of Jekyl Creek	do	10.30 a. m.	0	14.1	10.55			
Jekyl Creek, opposite mouth of Mud River.	do	10.40 a. m.	0	14.9	9.63			
Mid Creek	do	11 a. m.	0	14.8	10.43			
St. Andrew Sound Light	Feb. 10	7 a. m.	0	14.8	17.90		33.7	
Cumberland Sound	do	11 a. m.	0	14.6	12.0		24.1	7.6
Opposite mouth Brickhill River.	do		8	13.9	13.1	2.0	42.1	7.8
Kings Bay	do	5 p. m.	0	16.5	13.0			7.6
Do.			3.5	13.9	13.0		24.1	7.6
Cumberland Sound near Marsh Island.	Feb. 10		0	15.2	12.27	3	37.5	7.8
Opposite Kings Bay	Feb. 11	8.25 a. m.	7	15.0	13.12		34.9	7.8
St. Marys River just above mouth of Jolly Creek.	do	10.30 a. m.	0	15.2	22.36			8.4
Floyds Creek	Feb. 12	12 noon	0	13.2	9.51		913.0	7.5
Plantation Creek	Feb. 13	11 a. m.	0	11.2	9.63			
Back River	do	11.20 a. m.	0	12.2	10.28			
Mackays River	do	12.10 p. m.	0	12.1	3.35		44.6	
Mackays River opposite Wilsons Creek.	do	12.55 p. m.	0	11.3	Fresh.			
Buttermilk Sound	do	1.22 p. m.	0	10.9	Fresh.			
Darien River above 3-mile cut	do	1.55 p. m.	0	11.1	Fresh.			
Old Teakettle Creek	Feb. 16	4.20 p. m.	0	13.9	Fresh.			
North River opposite Doboy Island.	Feb. 28	9.25 a. m.	0	13.9	7.14			
Doboy Sound	do	do	0	14.5	16.85			
Doboy Island, red buoy	do	9.43 a. m.	0	14.3	15.01		15.0	
Old Teakettle Creek	do	10 a. m.	0	13.8	13.04		23.3	
Mud River opposite mouth of Teakettle Creek.	do	10.30 a. m.	0	13.9	12.52		206.7	
Mud River opposite mouth of Eagle Creek.	do	11 a. m.	0	14.9	16.73			
Sapelo Sound opposite High Point (red buoy).	do	11.07 a. m.	0	14.2	20.66		58.3	
Sapelo Sound opposite Quarantine.	do	11.30 a. m.	0	14.2	23.30			
South Newport River at red buoy.	do	11.45 a. m.	0	14.3	24.34			
Johnson Creek, south end	do	12 noon	0	14.6	21.33			
Johnson Creek, north end	do	12.35 p. m.	0	14.5	16.20			
Walburg Creek, south end	do	12.50 p. m.	0	14.1	14.49		33.4	
Walburg Creek, St. Catherine Island.	do	2 p. m.	0	14.5	20.05		27.7	8.0
North Newport River	Mar. 1		8	14.4	20.07		70.0	8.0
Entrance St. Catherine Sound		9.35 a. m.	0	14.0	15.28			

[1] Very muddy.

TABLE 1. *Survey of Georgia coastal waters, February March, 1925*—Continued

Stations	Date	Time	Depth (meters)	Temperature, ° C.	Salinity (parts per 1,000)	Transparency (feet)	Suspended matter (mg. per liter)	pH
St. Catherine Sound, red buoy	Mar. 1	9.55 a. m.	0	14.0	15.28			
St. Catherine Sound opposite mouth of Kernel Island Creek.	do	10.10 a. m.	0	14.0	11.43			
Ashville Creek	do	10.18 a. m.	0	14.0	13.31	3		
Ashville Creek at dock	do	12.15 p. m.	0	15.2	13.09			
Do	Mar. 2	8 a. m.	0	12.4	13.96			
Sunbury Creek	do	8.30 a. m.	0	14.5	13.96			
St. Catherine Sound, red buoy	Mar. 3	9 a. m.	0	10.5	18.57		14.3	
Kilkenny Creek	do	1.45 p. m.	0	13.2	13.17			
Do	Mar. 4	7.30 a. m.	0	9.7	14.24			
Bear River, above mouth of Kilkenny Creek.	do	8 a. m.	0	11.0	8.44			
Florida Passage opposite Skippers Narrows.	do	10.30 a. m.	0	14.9	4.85	1.5	13.1	7.0
Do			4	14.9	6.31		15.2	7.0
Back River	Mar. 4	1 p. m.	0	14.4	12.65	2	10.7	
Do			10	13.8	12.79			
Ogeechee River	Mar. 4	11 a. m.	0	13.8	2.18			
Little Ogeechee River	do	11.40 a. m.	0	14.3	14.09		15.0	
Skidaway River	do	4 p. m.	0	13.9	15.81		19.3	7.8
Thunderbolt (midstream)	do	5 p. m.	0	13.3	15.68			
Turners Creek	Mar. 5	9 a. m.	0	12.1	12.27			
Tybee River	do	10 a. m.	0	11.7	14.23		15.3	
Confluence of Tybee River and Lazaretto Creek.	do	1.45 p. m.	0	12.7	18.57		28.8	
Skidaway Passage	Mar. 6	10.20 a. m.	0	10.5	14.23			
Bear River opposite Kilkenny Creek.	do	3 p. m.	0	13.5	14.09			
St. Catherine Sound near mouth of Bear River.	do	3.45 p. m.	0	12.3	20.06			
Walburg Creek	do	4.15 p. m.	0	13.1	19.89			
Timmons River	Mar. 7	9 a. m.	0	12.2	20.07	3	33.3	8.0
Do			7	12.4	20.11		81.4	8.1
Sapelo Sound, red buoy	Mar. 7	2.40 p. m.	0	14.8	21.58			
New Teakettle Creek	do	3.40 p. m.	0	14.3	18.04			
North River, opposite Doboy Island.	Mar. 11	4.30 p. m.	0	19.4	4.52			
Do			4	19.1	4.94		313.8	
Altamaha Sound	Mar. 11	11.35 a. m.	0	16.3	4.11	1	39.6	7.6
Do			6	15.0	11.91		122.2	7.9
Doboy Island	Mar. 12	8 a. m.	0	16.6	20.66		38.0	
Connegan River	do	8.30 a. m.	0	16.4	18.57			
Buzzard Roost Creek, opposite head of Dead River.	do	10 a. m.	0	16.3	16.60	0.5	28.1	
Do			6	16.9	17.25			
Back River	Mar. 12	2.30 p. m.	0	16.9	14.61		105.6	7.8
Do			6	16.7	16.46			7.8
Rockdedundy River	Mar. 13	8.30 a. m.	0	16.2	16.46		39.6	7.9
Do			5	16.2	18.77		306.2	7.9

Several conclusions can be drawn from the examination of Table 1 and Figures 1 and 2. During the first half of February, fresh-water conditions prevailed in the vicinity of Altamaha Sound and Doboy Island. The water of this region contained up to 449.6 milligrams per liter of suspended matter; consequently, its transparency was very low (0.2 feet, Altamaha Sound). Its reaction in Altamaha River and adjacent streams was acid (pH 5.8 to 6.1), probably because of the addition of water washed from the swamps, while the water in the sounds and river not affected by the flood remained alkaline (pH 7.3 to 8.4). Flood waters did not extend to St. Andrews Sound and the mouth of St. Marys River, where the salinity was 17.9 and 22.3, respectively. In March, the salinity of the water in Altamaha Sound rose to 4.1 on the surface and 11.9 at the bottom.

In certain streams (Rockdedundy River, North River), the water was still very muddy, carrying over 300 milligrams of suspended matter per liter.

All the observations north of Doboy Island were made between February 28 and March 12, 1925. The salinity of the water varied, depending on the distance from the ocean and local conditions, from 2.18 (Ogeechee River) to 20.16 per mille (Sapelo Sound). The pH value of the water was from 7.0 to 8.1; and the amount of material in suspension, with the exception of Mud River, the water of which carried 206.7 milligrams of clay per liter, varied from 13.1 to 81.4 milligrams per liter. During the survey the temperature of the water recorded at various stations varied from 10.1° to 19.4° C. (about 50° to 67° F.).

It is a well-known fact that a substantially firm and unshifting bottom is a prerequisite for the successful cultivation of oysters. Unfortunately, our method of determining the consistency of the bottom is very primitive; it consists in trying the bottom with a sounding pole to which a metal disk is attached and in expressing the impression—gained by gently forcing the pole in the mud—in arbitrary terms: Ooze, very soft, soft, sticky, hard, etc. In 1910, Moore (1913) made an attempt to introduce an apparatus for measuring the consistency of bottoms. Unfortunately, his instrument is very heavy and can not be operated from a small boat. During the present survey the bottoms were examined by using the sounding pole, and samples of various representative types of mud were collected and preserved for further analysis.

By taking into consideration all the ecological conditions observed during the survey of 1925 (character of the bottom, salinity, pH, temperature, currents, and distribution of setting) it is possible to arrive at some conclusions as to the suitability of the various sections of Georgia coastal waters for oyster culture. Because of the brief period of observation, such conclusions can not be regarded as final, but can be used as a point of departure for further investigations. Before giving a list of the localities which the senior author thinks are suitable for oyster farming and which he believes can be profitably developed into productive grounds, it is desirable to analyze in a more general way the different classes of coastal waters with reference to their adaptability for the purpose. The question arises in which of three classes of waters—in the sounds, in the mouths of the rivers, or in small tidal creeks and marshes—one should expect to find conditions most favorable for the cultivation of oysters.

LOCALITIES SUITABLE FOR OYSTER CULTURE

The sounds are characterized by their sandy and shifting bottoms; their waters are exposed to heavy seas from the ocean and readily become choppy when tides are running against the wind; and the salinity is rather high. All these factors make the sounds unsuitable for oyster culture; and though there are several localities in the sounds where oysters grow and where the bottom is suitable, it would be unwise to recommend any oyster planting there. The one exception which should be mentioned is the inside part of Cumberland Sound along the shores of Cumberland Island and around the marsh islands. This locality is well protected from heavy seas and seems to be suitable for oyster culture.

The mouths of the rivers present a great variety of bottom conditions from hard and sticky mud, very suitable for oyster culture, to entirely unsuitable soft mud and sand. The salinity of the water is subject to great seasonal and daily fluctuations, depending on the stage of the river and tide. The water of the large rivers, like the Savannah and Altamaha, is muddy and contains a considerable amount of suspended material which is deposited at their mouths. Better conditions can be found in the smaller clear-water rivers such as the Satilla and St. Marys, but even in these the sudden changes caused by freshets may produce disastrous results. The heavy deposition of silt, low salinity especially during the freshets, and strong currents make any oyster culture here very difficult.

The third class of waters includes the tributaries of the principal streams, tidal rivers, and a large number of narrow creeks and salt marshes. The bottom here varies from very soft mud, unsuitable for oyster planting, to hard blue mud, which is considered very desirable for oyster culture; sand bottom occurs rarely. Though the rise and fall of tide can be regarded as uniform for the whole coastal region, averaging 7 to 8 feet, the tidal currents here are considerably slower than in the sounds. The salinity of the water naturally varies, depending on the distance from the ocean and the stage of the rivers. It can be roughly estimated that 6 to 8 miles from the ocean beach is the average limit of brackish water. Further inland the salt marshes pass into tidal swamps, which at high tide are partly covered by the backing up of the fresh river water. Small creeks and marshes are well protected from the rough sea. Their water is rich in the microscopic organisms which constitute the natural food of the oysters, and wherever the salinity and bottom conditions are right, they can be regarded as suitable for oyster culture. There are no natural beds located in the marshes, but where the oysters were introduced they grew rapidly and acquired good flavor. These waters should, therefore, be regarded as very suitable for oyster propagation. The total area of salt marshes probably measures between 150 and 200 square miles (estimated by L. W. Stephenson and J. O. Veatch); but since no survey of the marshlands of the State has yet been made, accurate figures can not be given. The figures just mentioned can be regarded as very conservative. They mean that there are between 96,000 and 128,000 acres of salt marshes, a considerable portion of which can be used for oyster culture. It is opinion of the senior writer, based on the observations of the survey of 1925, that large areas of salt marsh and small creeks can be adapted for oyster planting.

We can see from the foregoing pages that considerable areas can be found in the Georgia tidewater region that can be exploited for oyster culture. For this purpose the small streams, creeks, and marshes are preferable to mouths of the large rivers and open sounds where oysters may be buried by shifting bottoms and the deposition of silt, killed by freshets, or attacked by enemies such as drills and starfishes which avoid brackish waters.

The following localities visited during the survey are regarded as particularly suitable for oyster culture: Oyster Creek, Tybee Island; Black River, Burnside Island; Newell Creek, Ossabaw Island; Sunbury Creek, Medway River; Ashville Creek and surrounding marshes, Timmons River; Blackbeard River, Sapelo Island; Dead River, Folly River, and surrounding marshes; Duplin River; and Doboy Island and vicinity.

OBSERVATIONS AND EXPERIMENTS IN OYSTER CULTURE AT DOBOY ISLAND

In order to outline more specifically the best method of oyster culture suitable to local conditions, a number of observations and experiments were carried out in the summer of 1927 by J. H. Weatherby at Doboy Island. It must be borne in mind that ecological conditions of inshore waters along the Georgia coast are quite different from those of New England and Long Island Sound, where oyster farming has been in operation for more than 60 years, and that consequently the methods and experience gained in the cultivation of oysters in the northern latitudes are not directly applicable to the waters of the South Atlantic States. The very complex topography of the coastal region of Georgia presents difficulty in selecting a representative location. Probably no location along the coastal line could be called typical for the whole section.

The decision to carry out experimental work in the vicinity of Doboy Island was influenced by several considerations: The State authorities promised to provide on the island quarters suitable for a field laboratory; the island is easily accessible from either Darien or Brunswick; several productive oyster beds are found in its vicinity, and the bottoms near by present a great variety of conditions, from very soft mud to hard-shelled grounds; and, finally, it has been known that setting of oysters in the vicinity of Doboy Island is usually good. In June, 1928, a primitive dwelling was provided by the State in which a temporary laboratory was established. The work was, however, greatly handicapped by the adverse conditions under which the bureau's investigator worked and lived. Sultry heat; swarms of sand flies, mosquitoes, ants, and other insects infesting the laboratory; the dilapidated state of the building; and the difficulty of obtaining help on the small, isolated island, surrounded by marshes, constituted considerable obstacles in carrying out the program of observations. The latter consisted in taking daily temperature and salinity readings, in a study of tidal currents, in collecting quantitative plankton samples, and in experiments with brush and wire-bag spat collectors. The work continued from June 22 until September 1.

BRIEF DESCRIPTION OF THE LOCALITY

Doboy Island is located at the confluence of the North and Black Rivers and Doboy Sound. (Fig. 1.) A narrow canal separates it from Commodore Island on the east. The greatest part of the island is salt marsh, and only a small portion of it in the southwestern corner is occupied by high land. The channel along the western shore of the island and in the North River is from 19 to 27 feet deep, with very steep banks. The bottom and flats along the northeastern shore of North River are hard, while soft mud prevails on the bottom of the channel and on the flats farther up the river. Sticky mud is found between Doboy and Commodore Islands. At high tide, sea water enters the channel from Doboy Sound through the mouth of North River, while fresh water from Darien River is brought in by North and Rockdedundy Rivers.

On the western shore of the island there is a dock extending nearly to the channel from which daily observations of temperature, salinity, and plankton were carried out. The rocks on the banks and on the pillars of the dock were well covered with oysters.

TEMPERATURE AND SALINITY OF THE WATER

Daily observations of temperature and salinity of the water made during the period from June 22 to August 31, 1928, are shown in Figure 11 and Table 2, together with the data on precipitation and maximum and minimum air temperatures. The latter were taken from the records of the nearest meteorological station, at Brunswick. An examination of Figure 11 shows that by the end of June the water temperature was already above 26° C. (79° F.) and that it remained around this figure throughout the summer. The curves of maximum and minimum air temperatures remained at their respective levels without showing any definite rise or fall. As would be expected, their fluctuations from day to day were more pronounced than those of the water temperatures.

These thermal conditions, typical for the coastal region of Georgia, the climate of which is characterized by long, hot summers during which the changes in temperature from day to day are very small, are distinctly different from those observed in Long Island Sound and other inshore areas of the North Atlantic States, where during the summer the temperature of the water gradually rises until it reaches its maximum, usually during the second or third week of August. The fact that water temperature in Georgia remains nearly constant throughout the summer must have a pronounced effect on spawning of oysters. It has been shown by the experiments of Galtsoff (1930) that temperature is one of the important factors stimulating the discharge of the sex products by the oysters. Prytherch (1929) has demonstrated that spawning of oysters in Long Island Sound usually is coincident with the rise of temperature of the water. These observations were confirmed by Galtsoff (unpublished reports) for Wareham River and Onset Mass., where it has been noticed that oysters begin to spawn almost simultaneously after the temperature has reached its highest point. It is permissible to assume that in the localities when the temperature remains nearly constant for a period of several months environmental changes other than temperature may enter into play and become the controlling factors. Unfortunately, observations at Doboy Island began rather late (end of June), when the temperature of the water had already reached 26° C. (79° F.); that is, it was 6° higher than the lowest temperature (20° C., 68° F.) at which, according to Galtsoff (1930), oysters may spawn. It is not

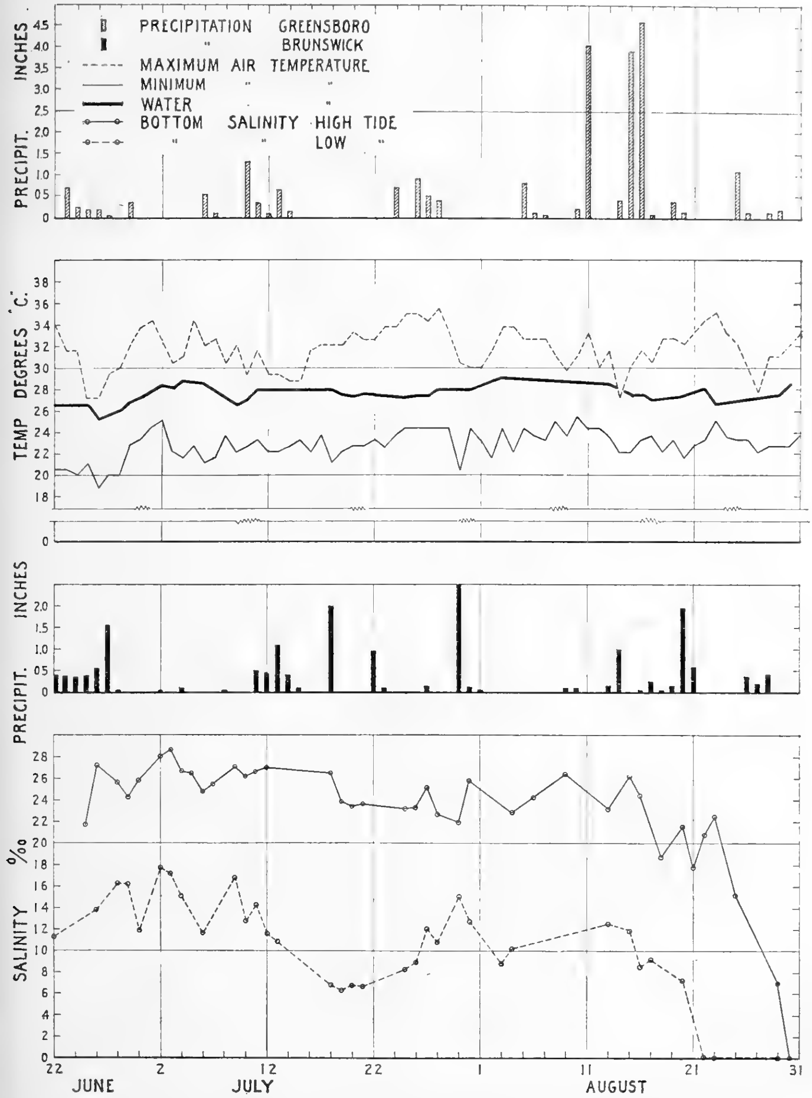

FIGURE 11.—Precipitation, air temperature, water temperature, and salinity at Doboy Island, Ga., June 22 to August 31, 1928

known whether oysters around Doboy Island had spawned early in the season; but according to observations made by Weatherby, there was no setting around Doboy Island that could be attributed to an early spawning.

TABLE 2.—*Daily temperature and salinity of the water at Doboy Island, Ga., June to August, 1928*

Date	Low water					High water				
	Time	Temperature, ° C.		Salinity per mille		Time	Temperature, ° C.		Salinity per mille	
		Top	Bottom	Top	Bottom		Top	Bottom	Top	Bottom
June 23	6.00 p. m.	27.0	26.5	10.26	11.08	--------	--------	--------	--------	--------
25	--------	--------	--------	--------	--------	2.40 p. m.	27.5	26.5	13.25	21.78
26	9.40 a. m.	26.0	25.3	12.09	13.89	3.30 p. m.	26.0	25.9	20.46	27.39
28	10.45 a. m.	27.0	26.0	13.39	16.39	4.45 p. m.	27.0	26.0	22.23	25.72
29	11.30 a. m.	27.5	26.8	13.25	16.18	5.20 p. m.	28.0	26.9	21.80	24.23
30	12.35 p. m.	28.0	27.2	11.87	11.87	6.20 p. m.	27.5	27.0	25.28	25.90
July 2	1.50 p. m.	29.0	28.4	16.01	17.76	7.40 p. m.	28.0	27.4	26.63	28.03
3	2.30 p. m.	29.0	28.2	17.21	17.21	8.00 p. m.	28.0	27.8	27.95	28.75
4	3.00 p. m.	29.5	28.8	14.79	15.08	8.40 a. m.	28.5	27.6	22.94	26.76
5	--------	--------	--------	--------	--------	9.20 a. m.	28.5	28.0	14.60	26.55
6	4.00 p. m.	28.5	28.0	13.94	14.20	10.00 a. m.	28.0	26.1	23.40	24.80
7	--------	--------	--------	--------	--------	10.10 a. m.	27.5	27.6	23.80	25.55
9	7.10 p. m.	28.0	26.6	13.96	16.82	1.10 p. m.	28.0	27.2	27.41	27.21
10	7.30 a. m.	28.0	27.0	13.62	13.56	2.00 p. m.	28.0	27.2	26.20	26.44
11	8.40 a. m.	28.0	28.0	13.88	14.29	3.00 p. m.	28.5	28.5	26.82	27.63
12	9.30 a. m.	28.0	28.0	11.47	11.60	3.40 p. m.	28.0	27.5	27.02	27.10
13	10.30 a. m.	28.0	28.0	10.90	10.90	--------	--------	--------	--------	--------
18	3.15 p. m.	28.5	28.0	6.71	6.83	9.20 a. m.	28.0	26.2	17.77	26.49
19	4.00 p. m.	28.5	27.6	6.44	6.38	9.40 a. m.	28.5	26.6	10.72	23.96
20	4.45 p. m.	28.0	27.4	6.38	6.78	10.38 a. m.	30.0	26.8	10.03	23.48
21	5.35 p. m.	28.0	27.6	6.11	6.65	11.30 a. m.	29.0	26.6	11.81	23.70
25	8.30 a. m.	27.5	27.2	5.39	8.35	2.10 p. m.	30.0	26.4	9.81	23.21
26	9.30 a. m.	27.5	27.5	8.93	9.60	3.30 p. m.	28.0	27.5	10.79	23.40
27	10.15 a. m.	28.0	27.5	9.98	12.15	4.00 p. m.	28.0	28.0	11.38	25.15
28	10.40 a. m.	28.0	28.0	10.26	10.80	5.15 p. m.	29.0	26.5	21.38	22.73
30	12.30 p. m.	29.0	28.0	14.40	15.09	8.30 a. m.	27.5	27.2	19.06	21.92
31	1.00 p. m.	28.0	28.0	15.96	16.17	7.30 a. m.	27.5	27.0	23.21	25.68
Aug. 3	3.20 p. m.	30.0	29.0	8.68	8.75	--------	--------	--------	--------	--------
4	4.05 p. m.	30.0	29.0	9.69	10.03	9.50 a. m.	29.5	29.0	21.72	24.81
6	--------	--------	--------	--------	--------	11.30 a. m.	30.0	30.0	23.41	24.20
9	--------	--------	--------	--------	--------	2.30 p. m.	29.0	28.4	24.81	26.42
13	12.10 p. m.	28.5	28.5	11.98	12.47	6.30 p. m.	27.5	27.5	21.27	23.12
15	2.00 p. m.	27.5	27.5	11.43	11.82	8.00 a. m.	27.5	27.0	22.14	26.16
16	3.00 p. m.	27.5	27.5	9.69	9.81	8.30 a. m.	27.5	27.0	20.95	24.08
17	3.40 p. m.	27.5	27.0	8.77	9.16	--------	--------	--------	--------	--------
18	--------	--------	--------	--------	--------	10.00 a. m.	28.0	27.2	15.41	18.72
20	5.40 p. m.	27.5	27.5	6.26	7.18	11.30 a. m.	29.0	27.2	7.55	21.53
21	--------	--------	--------	--------	--------	12.00 noon	29.0	27.4	8.62	17.65
22	7.15 p. m.	30.0	28.0	0	0	1.00 p. m.	30.0	27.6	0	20.72
23	8.00 a. m.	27.0	26.8	0	0	2.00 p. m.	29.0	27.8	0	22.26
25	--------	--------	--------	--------	--------	3.50 p. m.	28.5	28.8	0	15.15
29	1.10 p. m.	27.5	27.5	0	0	7.00 p. m.	28.0	28.0	0	6.92
30	1.30 p. m.	29.0	29.0	0	0	7.30 a. m.	27.5	27.5	0	0

For observations of salinity, top and bottom samples of water were taken twice a day within 30 minutes of exact time of high and low water. All the samples were collected from the end of the dock at Doboy Island; the determinations of salinity computed from hydrometer readings are accurate within ±0.05 per cent.

The concentration of salts in the water around Doboy Island is subject to wide daily fluctuations depending on the stage of the tide. There were but slight differences in the concentration of salts in top and bottom samples, but the differences in the salinities of high and low water were large, sometimes reaching 20 points. This fact can be noticed by examining Figure 11, where the daily bottom salinities observed at high and low water are plotted. After August 21, due to the rise of the Altamaha River, there was a sharp decline in the salinity, the water remaining fresh until the end of the month. That the drop in salinity at Doboy Island should be attributed to the rise of the river stage rather than to local precipitation is clear from the examination of Figure 11, the upper and the third curves of which indicate precipitation (in inches) in Greensboro and Brunswick. Greensboro is located at the head of Altamaha River, over 200 miles northwest from Doboy Island, while Brunswick is located in the coastal region about 20 miles south of Doboy Island. An examination of curves shows that local precipitation (Brunswick) was not followed by any noticeable decrease in the salinity of the water at Doboy; while the rains in Greensboro, which began on August 11 and continued for a week, were followed 10 days later by a sharp decline in the salinity. Daily discharge data of Altamaha River made by the United States Weather Bureau show that since August 20 the river at Everett City was at flood stage (10 feet and above). Flood conditions prevailed until October 2, when the water dropped to 9.7 feet.

TIDAL CURRENTS

The organisms of the coastal region are exposed to regular changes in their environment caused by the rhythmical tidal motion of the water. The length of time they remain out of water, the temperature, velocity of the currents, osmotic pressure, and chemical composition of the water vary with every change of tide and are dependent on the tidal range. Each of these factors may have a pronounced effect on the organisms and may control their growth and propagation. Hence, an understanding of the tidal conditions is essential in determining the extent of changes in the environment which the bottom and shore organisms of a given locality must endure.

One of the striking features of the tidal motion is the change in the velocities of the current that accompany the rise and fall of the tide. We know that the direction and duration of tidal currents and their velocity depend on the range of tide and on the configuration of the tidal basin. According to the United States Coast and Geodetic Survey, the mean range of tide around Doboy Island is 6.8 feet, with the spring range reaching 8 feet. A study of the changes in the velocities of the current at Doboy Island was made for both spring and neap tides. Observations during spring tides were carried out on July 3, 31, and August 16, 30, 1928, and April 24, 1929; observations of July 10 and August 23, 1928, and May 2, 1929, fall on neap tides. The results of the observations are presented in Figures 12 to 18 and Tables 3 and 4. The range of tide was recorded on the tidal gage set under the dock at Doboy Island. The heights of tide in feet were recorded from an arbitrary zero level which was set about 4 feet below low-water mark. The direction and the velocity of current were determined by means of an Eckman current meter (old model). It can be noticed from an examination of Figures 12 to 18 that no significant differences in current velocities were observed between the spring and neap tides, and that the highest current velocities of 97.5 and 116 centimeters per second were observed on August 16 (spring tide) and August 23 (neap tide). (Figs. 14, 17.)

The tides around Doboy Island are characterized by the very high velocity of the ebb tide and the rather weak irregular velocities of the flood tide. The highest velocity of the surface current occurs in most cases between three and one-half and four and one-half hours after high water. There is no significant difference between the surface and bottom current. (Fig. 18.)

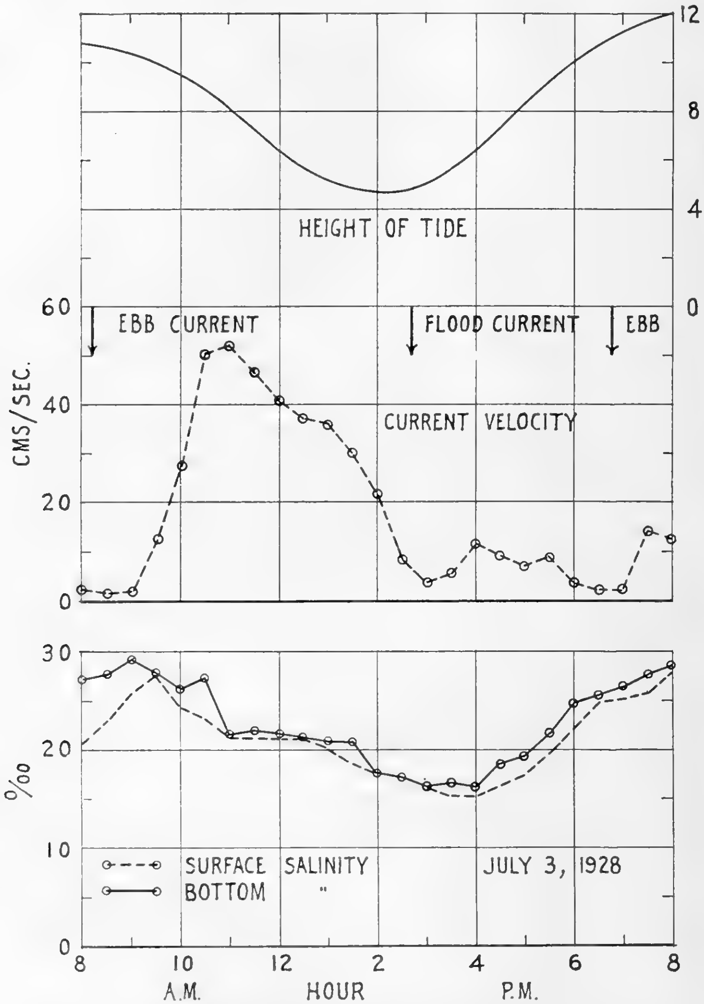

FIGURE 12.—Salinity and surface currents during the tidal cycle at Doboy Island, July 3, 1928, spring tide

The time of slack water (zero velocity) is influenced by the stage of the river. On July 3, 1928, and April 24, 1929, it nearly coincided with the time of high and low water. (Figs. 12, 18.) In August 1928, when the Altamaha River was approaching flood stage, the zero velocities were observed about two hours after the low water and one and one-half hours before high water (August 16, fig. 14). In all the observations, the velocities of the flood current were rather

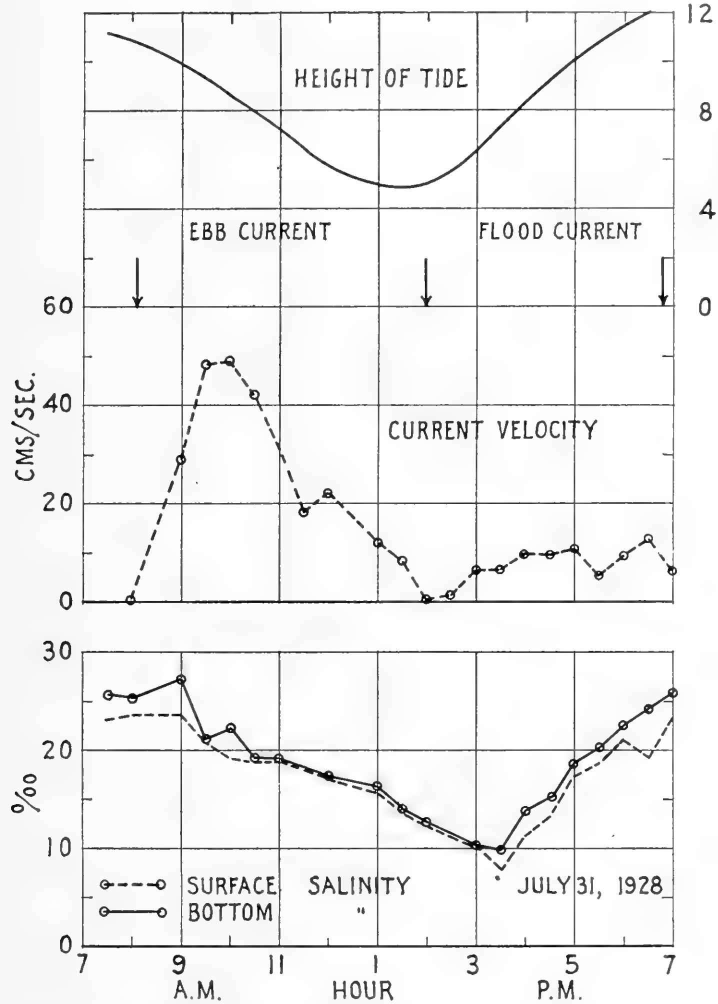

FIGURE 13.—Salinity and surface currents during the tidal cycle at Doboy Island, July 31, 1928, spring tide

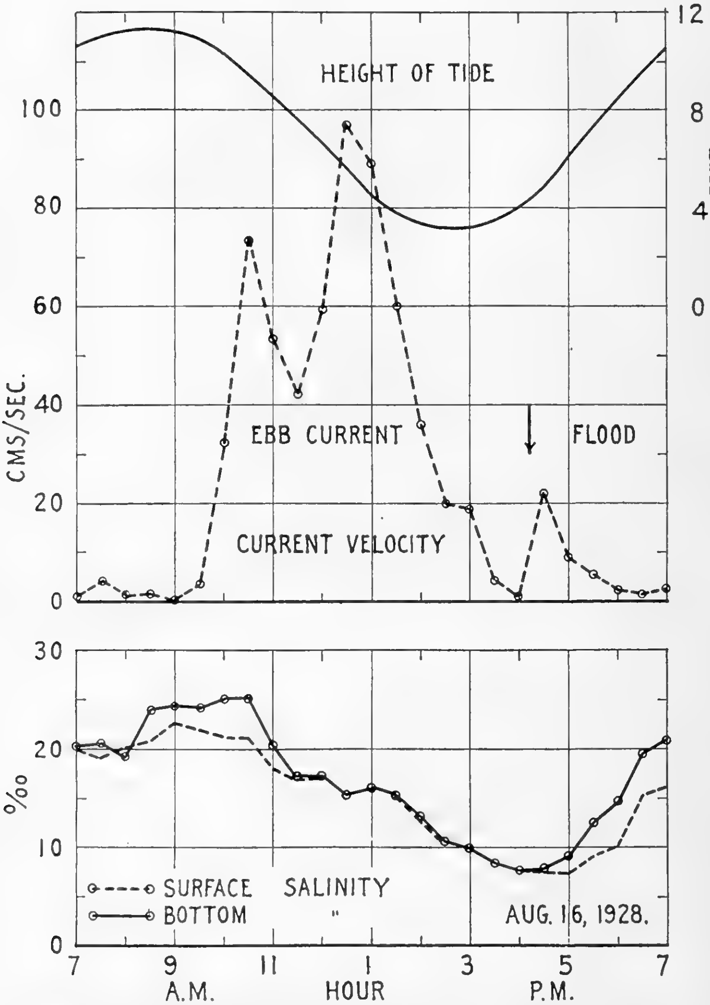

FIGURE 14.—Salinity and surface currents during the tidal cycle at Doboy Island, August 16, 1928, spring tide

irregular and less than the velocity of the ebb current. The duration of flood and ebb current varied considerably. At the normal stage of the river, both currents were of approximately equal duration; with the rise of the river stage, the ebb current prevailed with a corresponding decrease in the duration of flood. On August 23, when the Altamaha River was at high stage, the flood current continued for only two hours. (Fig. 17.)

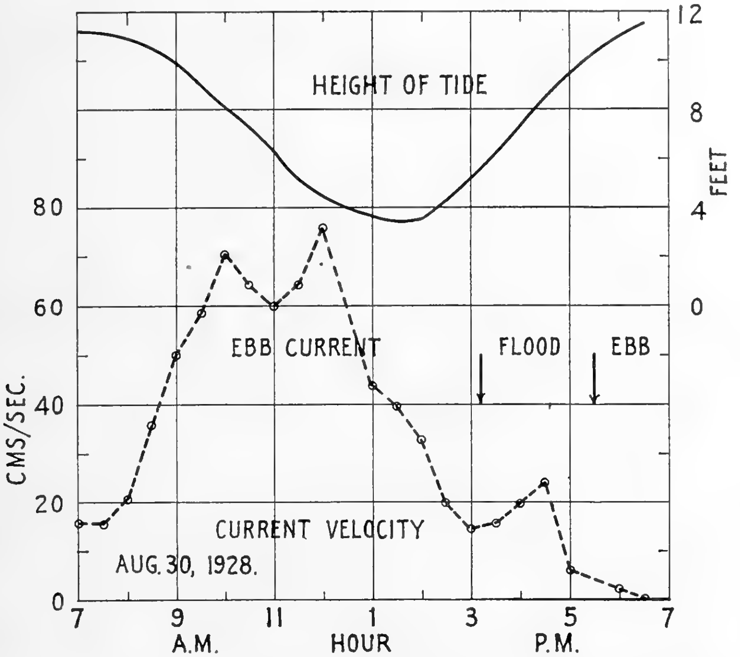

FIGURE 15.—Surface currents during the tidal cycle at Doboy Island, August 30, 1928, spring tide

In the spring of 1929 the direction of flow of the surface ebb current was generally NNE., but varied slightly to NE., N., and N. by W. The direction taken by the bottom ebb current followed that of the surface current rather closely (Tables 9 and 10), except that at the one point where the surface swung N. by W. the bottom current swung N.

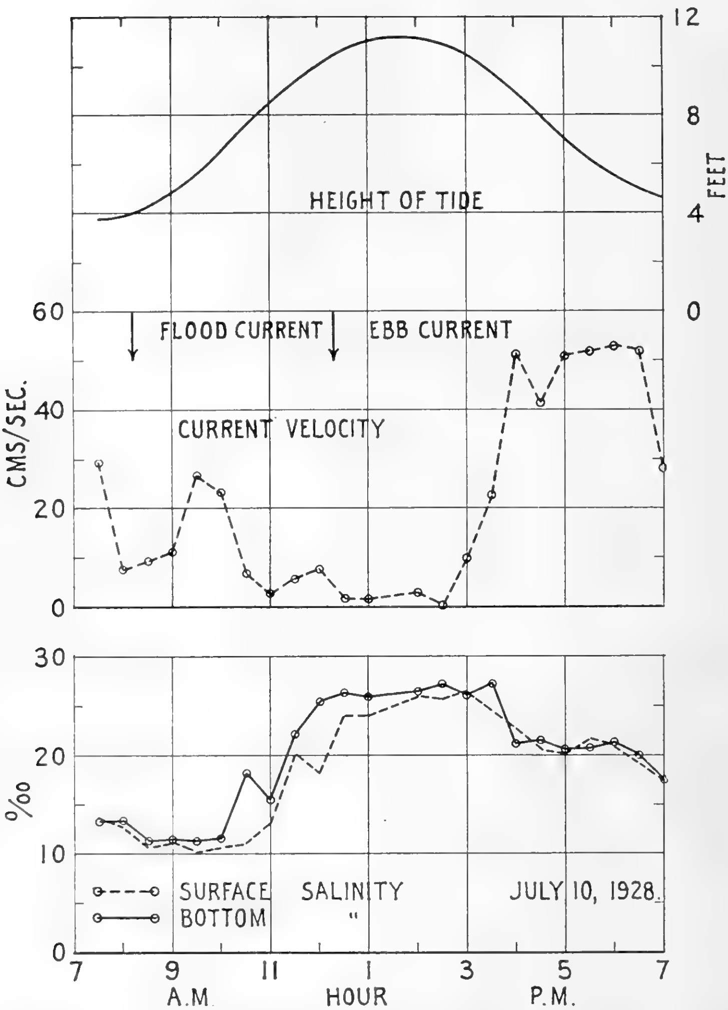

FIGURE 16.—Salinity and surface currents during the tidal cycle at Doboy Island, July 10, 1928, neap tide

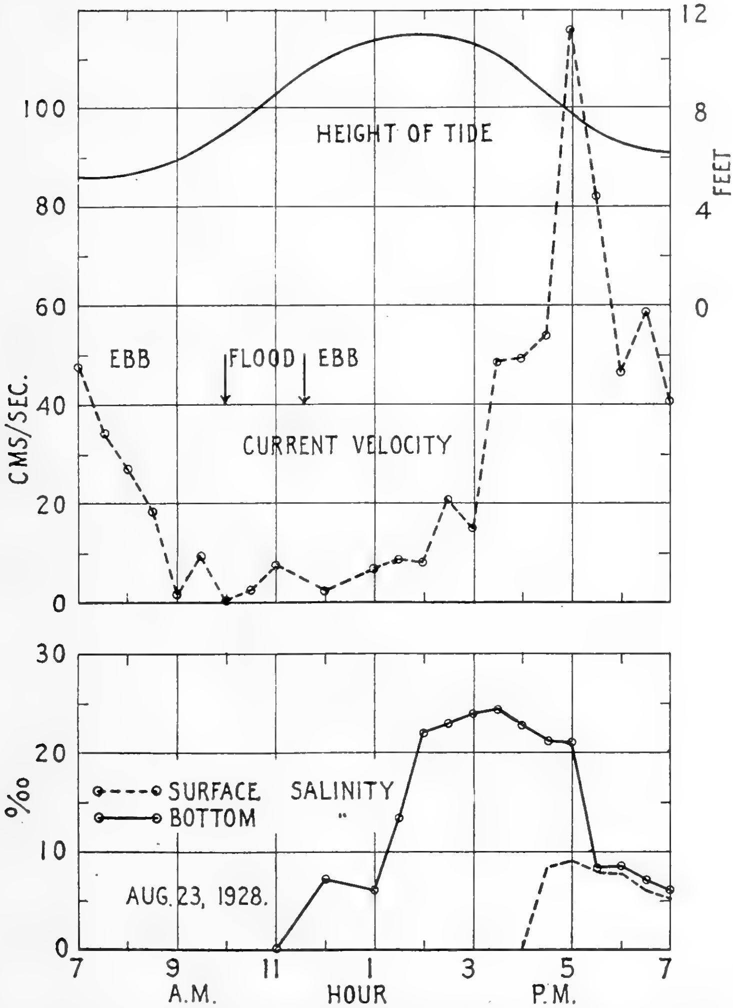

FIGURE 17.—Salinity and surface currents during the tidal cycle at Doboy Island, August 23, 1928, neap tide

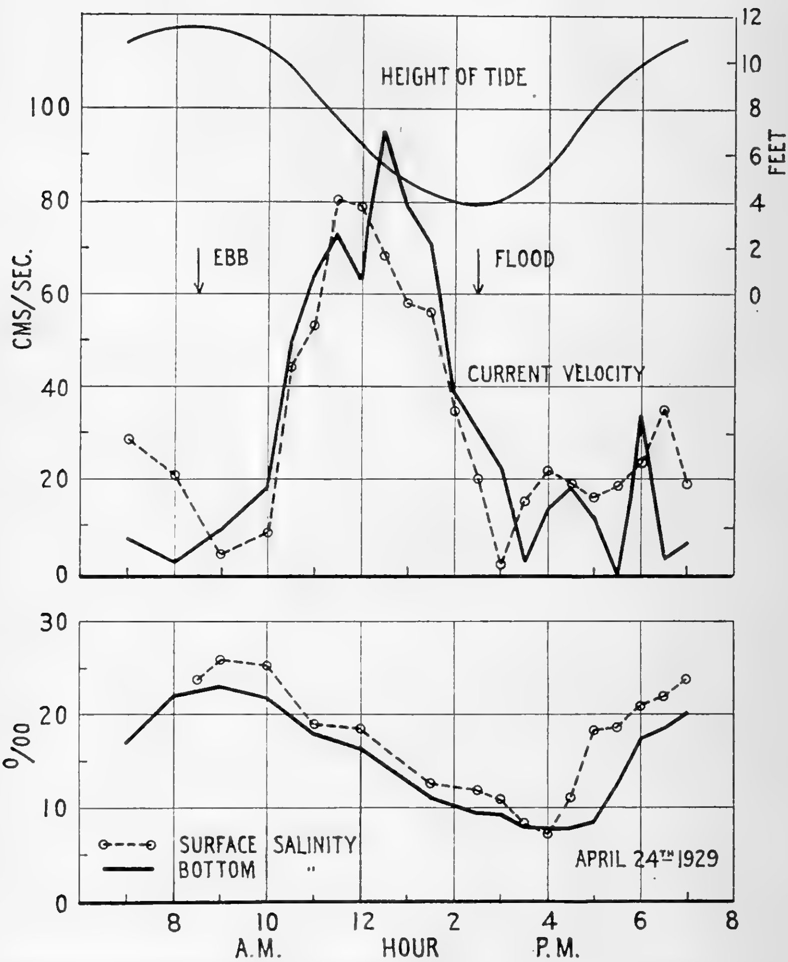

FIGURE 18.—Salinity and surface currents during the tidal cycle at Doboy Island, April 24, 1929, spring tide

TABLE 3.—*Water temperature, salinity, and current velocity at Doboy Island*

JULY 3, 1928 (SPRING TIDE)

Hour	Tide stage in feet	Temperature, ° C. Surface	Temperature, ° C. Bottom	Salinity per mille Surface	Salinity per mille Bottom	Surface current Velocity (cms./sec.)	Surface current Direction
8 a. m.	10.8	27.5	27.7	20.56	27.36	2.05	SW.
8.30 a. m.	10.6	28.0	27.2	22.74	27.90	1.88	NE.
9 a. m.	10.4	28.0	27.2	25.95	28.10	1.88	NE.
9.30 a. m.	10.0	28.0	27.3	27.41	27.83	12.62	NE.
10 a. m.	9.5	28.0	27.6	24.42	26.35	27.43	NE.
10.30 a. m.	9.0	28.0	27.6	23.13	27.41	50.33	NE.
11 a. m.	8.0	28.5	28.1	21.34	21.47	52.09	NE.
11.30 a. m.	7.3	28.0	28.0	21.34	22.00	46.81	NE.
12 noon	6.4	28.5	28.2	21.47	21.73	41.52	NE.
12.30 p. m.	5.7	29.0	28.2	21.38	21.26	37.12	NE.
1 p. m.	5.3	29.0	28.2	20.05	20.85	36.76	NE.
1.30 p. m.	4.9	29.0	28.2	18.57	20.85	30.24	NE.
2 p. m.	4.7	29.0	28.2	17.76	17.76	22.67	NE.
2.30 p. m.	4.7	29.0	28.2	17.21	17.21	8.57	NE.
3 p. m.	5.0	29.0	28.4	16.15	16.15	4.70	SW.
3.30 p. m.	5.6	29.0	28.8	15.28	16.55	5.93	SW.
4 p. m.	6.3	29.5	29.0	15.15	15.53	11.57	SW.
4.30 p. m.	7.3	29.5	29.2	16.35	18.57	9.10	SW.
5 p. m.	8.3	29.5	29.0	17.41	19.44	7.16	SW.
5.30 p. m.	9.2	29.0	28.8	19.58	21.58	8.92	SW.
6 p. m.	10.0	28.5	28.4	22.20	24.87	3.29	SW.
6.30 p. m.	10.6	28.5	27.8	24.60	25.48	2.76	SW.
7 p. m.	11.2	28.5	27.8	25.21	26.48	2.76	NE.
7.30 p. m.	11.6	28.0	27.8	25.81	27.69	14.21	NE.
8 p. m.	11.9	28.0	27.8	27.95	28.75	12.98	NE.

JULY 10, 1928 (NEAP TIDE)

Hour	Tide stage in feet	Temperature, ° C. Surface	Temperature, ° C. Bottom	Salinity per mille Surface	Salinity per mille Bottom	Surface current Velocity (cms./sec.)	Surface current Direction
7.30 a. m.	3.8	28.0	27.0	13.62	13.56	27.19	NE.
8 a. m.	3.8	28.0	27.0	12.68	12.77	7.16	NE.
8.30 a. m.	4.2	28.0	27.6	10.93	11.43	9.10	SW.
9 a. m.	4.7	28.0	27.4	11.06	11.43	11.57	SW.
9.30 a. m.	5.5	28.0	27.6	10.26	11.33	26.54	SW.
10 a. m.	6.5	28.0	27.6	10.80	11.60	23.20	SW.
10.30 a. m.	7.3	28.0	27.6	11.19	18.17	6.81	SW.
11 a. m.	8.5	28.0	27.4	13.08	15.48	2.76	SW.
11.30 a. m.	9.3	28.0	27.5	20.32	22.38	5.40	SW.
12 noon	10.0	28.0	27.6	18.17	25.55	7.69	SW.
12.30 p. m.	10.7	28.0	28.0	24.22	26.48	1.88	NE.
1 p. m.	11.0	28.0	28.0	24.22	26.08	1.88	NE.
2 p. m.	11.1	28.0	27.2	26.20	26.44	2.05	NE.
2.30 p. m.	11.0	28.0	27.4	25.81	27.21	0	----------
3 p. m.	10.5	28.0	27.4	26.63	26.08	9.45	NE.
3.30 p. m.	10.0	28.0	27.6	24.74	27.41	23.90	NE.
4 p. m.	9.0	28.5	28.4	22.92	21.05	53.15	NE.
4.30 p. m.	8.1	28.5	28.4	20.72	21.52	42.93	NE.
5 p. m.	7.1	28.5	28.1	20.39	20.55	52.97	NE.
5.30 p. m.	6.4	28.0	28.4	21.80	20.91	54.38	NE.
6 p. m.	5.5	28.0	27.8	20.72	21.13	56.50	NE.
6.30 p. m.	5.2	27.5	28.0	19.20	19.92	54.38	NE.
7 p. m.	4.7	27.5	27.5	17.18	17.31	25.66	NE.

JULY 31, 1928 (SPRING TIDE)

Hour	Tide stage in feet	Temperature, ° C. Surface	Temperature, ° C. Bottom	Salinity per mille Surface	Salinity per mille Bottom	Surface current Velocity (cms./sec.)	Surface current Direction
7.30 a. m.	11.2	27.5	27.0	23.21	25.68	0	0
8 a. m.	11.0	27.5	27.0	23.60	25.21	0	0
9 a. m.	10.0	28.0	27.0	23.68	27.21	29.23	NE.
9.30 a. m.	9.3	28.0	27.3	20.86	21.38	46.81	NE.
10 a. m.	8.7	28.0	27.4	19.24	22.34	48.57	NE.
10.30 a. m.	8.0	28.0	27.4	18.86	19.24	42.40	NE.
11 a. m.	7.3	28.0	27.8	18.98	19.24	31.83	NE.
11.30 a. m.	6.6	28.0	27.8	18.44	18.44	18.62	NE.
12 noon	5.8	28.0	28.0	17.17	17.38	22.14	NE.
1 p. m.	5.1	28.0	28.0	15.96	16.17	12.45	NE.
1.30 p. m.	5.0	28.5	28.0	13.68	14.02	8.57	NE.
2 p. m.	5.0	28.5	28.0	12.47	12.68	0	0
2.30 p. m.	5.7	29.0	28.5	11.57	11.52	1.88	SW.
3 p. m.	6.3	29.5	29.5	10.36	10.36	6.28	SW.
3.30 p. m.	7.4	29.0	28.5	7.99	9.84	6.46	SW.
4 p. m.	8.0	29.2	28.5	11.44	14.00	9.45	SW.
4.30 p. m.	9.0	29.0	28.5	13.31	15.21	9.10	SW.
5 p. m.	10.2	28.5	28.0	17.45	18.92	10.86	SW.
5.30 p. m.	10.8	28.5	28.0	18.78	20.26	5.58	SW.
6 p. m.	11.4	28.5	27.5	21.06	22.61	9.45	SW.
6.30 p. m.	12.0	28.0	27.5	19.24	24.34	12.98	SW.
7 p. m.	12.3	28.0	27.5	23.53	25.81	6.46	NE.

TABLE 3.—*Water temperature, salinity, and current velocity at Doboy Island*—Con.

AUGUST 16, 1928 (SPRING TIDE)

Hour	Tide stage in feet	Temperature, ° C.		Salinity per mille		Surface current	
		Surface	Bottom	Surface	Bottom	Velocity (cms./sec.)	Direction
7 a. m.	10.7	27.5	27.0	19.99	20.34	1.17	NE.
7.30 a. m.	11.0	27.5	26.8	19.33	20.89	4.52	NE.
8 a. m.	11.2	27.0	26.8	20.14	19.33	1.17	NE.
8.30 a. m.	11.4	27.5	27.0	20.95	24.08	1.88	NE.
9 a. m.	11.3	27.5	27.0	22.61	24.47	0	0
9.30 a. m.	11.0	27.5	27.0	22.06	24.47	3.64	NE.
10 a. m.	10.5	28.0	27.0	21.40	25.23	32.18	NE.
10.30 a. m.	9.5	27.5	27.0	21.27	25.35	77.29	NE.
11 a. m.	8.7	27.5	27.2	18.31	20.53	57.38	NE.
11.30 a. m.	7.8	27.5	27.0	16.91	17.05	44.34	NE.
12 noon	6.7	27.5	27.2	17.11	17.18	59.47	NE.
12.30 p. m.	5.5	27.0	27.0	15.38	15.38	97.55	NE.
1 p. m.	4.5	27.5	27.0	16.64	16.49	89.27	NE.
1.30 p. m.	4.0	27.5	27.0	15.32	15.26	60.90	NE.
2 p. m.	3.6	27.5	27.0	12.92	13.12	36.59	NE.
2.30 p. m.	3.3	27.5	27.0	10.35	10.62	20.38	NE.
3 p. m.	3.2	27.5	27.5	9.69	9.81	19.14	NE.
3.30 p. m.	3.5	27.5	27.5	8.48	8.48	4.52	NE.
4 p. m.	4.0	27.5	27.5	7.82	7.82	1.88	NE.
4.30 p. m.	4.4	27.5	27.5	7.56	7.95	22.14	SW.
5 p. m.	6.2	27.5	27.0	7.82	9.41	9.45	SW.
5.30 p. m.	7.3	27.5	27.4	9.13	12.78	5.93	SW.
6 p. m.	8.5	27.0	27.4	10.35	14.76	2.40	SW.
6.30 p. m.	9.7	27.5	27.0	15.30	19.68	1.52	SW.
7 p. m.	10.6	27.0	27.0	16.18	21.02	2.76	NE.

AUGUST 23, 1928 (NEAP TIDE)

Hour	Tide stage in feet	Temperature, ° C. Surface	Temperature, ° C. Bottom	Salinity Surface	Salinity Bottom	Velocity (cms./sec.)	Direction
7 a. m.	5.2	27.0	26.6	0	0	47.34	NE
7.30 a. m.	5.2	27.0	26.8	0	0	34.47	NE.
8 a. m.	5.4	27.0	26.8	0	0	27.07	NE.
8.30 a. m.	5.6	27.0	26.9	0	0	18.79	NE.
9 a. m.	6.0	27.0	26.9	0	0	1.52	NE.
9.30 a. m.	6.5	27.5	27.0	0	0	9.81	NE.
10 a. m.	7.1	28.0	26.0	0	0	0	0
10.30 a. m.	7.8	28.0	26.0	0	0	2.40	SW.
11 a. m.	8.6	28.0	26.0	0	0	7.74	SW.
12 noon	10.0	28.0	26.4	0	7.38	2.40	NE.
1 p. m.	10.8	28.0	27.6	0	6.29	6.81	NE.
1.30 p. m.	10.8	28.5	27.0	0	13.50	8.92	NE.
2 p. m.	10.8	29.0	27.8	0	22.26	8.32	NE.
2.30 p. m.	10.8	29.0	27.6	0	23.07	20.91	NE.
3 p. m.	10.6	29.0	27.8	0	24.02	15.09	NE.
3.30 p. m.	10.0	29.0	27.6	0	24.42	48.75	NE.
4 p. m.	9.4	29.0	27.8	0	22.94	49.10	NE.
4.30 p. m.	8.6	29.0	27.0	8.50	21.19	54.03	NE.
5 p. m.	7.8	28.5	26.6	9.31	21.27	116.05	NE.
5.30 p. m.	7.3	28.0	26.0	7.92	8.44	82.22	NE.
6 p. m.	6.6	27.5	25.6	7.72	8.68	46.81	NE.
6.30 p. m.	6.3	27.5	25.5	6.08	7.27	58.79	NE.
7 p. m.	6.2	27.0	25.5	5.10	6.02	40.29	NE.

AUGUST 30, 1928 (SPRING TIDE)

Hour	Tide stage in feet	Temperature, ° C. Surface	Temperature, ° C. Bottom	Salinity Surface	Salinity Bottom	Velocity (cms./sec.)	Direction
7 a. m.	11.2	27.5	27.5	0	0	15.67	NE.
7.30 a. m.	11.0	27.5	27.5	0	0	15.37	NE.
8 a. m.	11.0	27.5	27.5	0	0	20.55	NE.
8.30 a. m.	10.6	27.5	27.5	0	0	35.35	NE.
9 a. m.	10.0	27.5	27.5	0	0	50.33	NE.
9.30 a. m.	9.0	27.5	28.5	0	0	58.79	NE.
10 p. m.	8.0	28.5	28.5	0	0	70.59	NE.
10.30 a. m.	7.3	28.5	28.5	0	0	64.60	NE.
11 a. m.	6.4	28.5	28.5	0	0	60.00	NE.
11.30 a. m.	5.2	28.5	28.5	0	0	64.43	NE.
12 noon	4.5	29.0	29.0	0	0	76.06	NE.
1 p. m.	3.8	29.0	29.0	0	0	43.81	NE.
1.30 p. m.	3.5	29.0	29.0	0	0	39.94	NE.
2 p. m.	3.5	29.0	28.5	0	0	32.89	NE.
2.30 p. m.	4.4	28.5	---------	0	0	19.67	NE.
3 p. m.	4.8	28.5	28.5	0	0	14.39	NE.
3.30 p. m.	6.5	29.0	29.0	0	0	15.27	SW.
4 p. m.	7.3	28.5	28.5	0	0	19.14	SW.
4.30 p. m.	8.0	28.5	28.5	0	0	23.90	SW.
5 p. m.	9.7	28.0	28.0	0	0	5.93	SW.
6 p. m.	11.0	28.0	27.5	0	0	2.05	NE.
6.30 p. m.	11.5	28.0	27.5	0	0	0	0

TABLE 4.—*Water temperature, salinity, and current velocity, Doboy Island*

APRIL 24, 1929 (SPRING TIDE)

Hour	Tide stage in feet	Temperature, ° C.		Salinity per mille		Surface current		Bottom current	
		Surface	Bottom	Surface	Bottom	Velocity (cms./sec.)	Direction	Velocity (cms./sec.)	Direction
7 a. m.	10.9	19.6	19.7	17.21	--------	7.43	NNE.	28.80	NNE.
8 a. m.	11.5	20.0	19.7	22.01	24.51	2.59	NNE.	21.24	NNE.
9 a. m.	11.4	19.8	19.7	23.78	26.22	9.32	NNE.	4.75	NNE.
10 a. m.	10.6	20.4	19.8	22.66	25.44	18.53	NNE.	9.08	N.
10.30 a. m.	9.8	--------	--------	--------	--------	48.15	N. by W.	44.50	N.
11 a. m.	8.5	20.4	20.0	18.06	19.16	64.22	N. by E.	53.64	N. by E.
11.30 a. m.	7.8	--------	--------	--------	--------	73.15	NE.	80.46	NE.
12 noon	6.4	20.4	20.3	16.98	18.22	63.09	N. by E.	79.85	N. by E.
12.30 p. m.	5.5	--------	--------	--------	--------	95.40	N. by E.	68.58	N. by E.
1 p. m.	5.1	--------	--------	--------	--------	79.24	N. by E.	58.21	N. by E.
1.30 p. m.	4.6	20.45	20.4	11.49	12.79	71.62	NNE.	56.08	NNE.
2 p. m.	4.4	--------	--------	--------	--------	37.79	NNE.	35.05	N.
2.30 p. m.	3.8	20.7	20.45	9.94	12.11	30.69	N.	20.42	NNE.
3 p. m.	4.0	20.7	20.5	9.63	11.29	23.16	N. by E.	2.31	?
3.30 p. m.	4.6	20.8	20.8	8.03	8.42	2.86	NNE.	15.84	N. by W.
4 p. m.	5.4	20.8	20.8	7.92	7.83	13.38	S. by W.	22.31	N. by W.
4.30 p. m.	6.8	21.0	20.8	8.37	11.49	18.80	S. by W.	18.53	S. by W.
5 p. m.	8.0	21.1	21.1	8.84	18.64	12.03	SSW.	16.64	SSW.
5.30 p. m.	9.0	21.16	20.84	12.99	18.86	0.00	----------	19.08	SSW.
6 p. m.	10.0	20.9	20.4	17.94	21.02	34.44	SSW.	23.92	SSW.
6.30 p. m.	10.5	20.8	20.3	18.86	22.14	3.10	NNE.	35.02	N. by E.
7 p. m.	11.0	20.6	20.1	20.46	24.96	6.37	NNE.	19.84	N. by E.

MAY 2, 1929 (NEAP TIDE)

Hour	Tide stage in feet	Temperature, ° C.		Salinity per mille		Surface current		Bottom current	
		Surface	Bottom	Surface	Bottom	Velocity (cms./sec.)	Direction	Velocity (cms./sec.)	Direction
6.30 a. m.	5.5	22.4	22.4	15.38	21.92	57.30	NNE.	25.84	N. by E.
7.30 a. m.	5.1	22.5	22.5	15.48	18.66	30.41	NEN.	20.69	N. by E.
6.30 a. m.	5.5	22.4	22.4	15.38	21.92	57.30	NNE.	25.84	N. by E.
7.30 a. m.	5.1	22.5	22.5	15.48	18.66	30.41	NNE.	20.69	N. by E.
8 a. m.	4.9	22.4	22.5	15.28	17.88	29.07	N. by E.	5.27	N. by E.
8.30 a. m.	5.0	22.6	22.8	13.78	16.79	11.47	N.	0.00	----------
9 a. m.	5.0	22.8	22.9	15.14	16.08	8.80	N. by E.	1.64	?
9.30 a. m.	5.4	23.0	22.7	15.66	15.70	18.53	NNE.	7.19	N. by E
10 a. m.	5.8	23.1	23.2	13.60	13.96	16.09	N. by E.	1.64	?
10.30 a. m.	6.2	23.2	23.1	13.51	13.91	0.00	----------	2.52	S. by W.
11 a. m.	6.9	23.0	23.0	13.71	13.75	2.31	S. by W.	2.52	S. by W.
11.30 a. m.	7.5	23.0	23.0	13.71	13.96	2.98	S. by W.	0.00	----------
12 noon	8.2	23.0	23.0	15.57	15.59	15.30	S. by W.	2.07	S. by W.
12.30 p. m.	8.7	23.0	22.9	14.49	18.52	4.32	S. by W.	0.00	----------
1 p. m.	9.2	23.0	22.9	15.35	18.60	----------	----------	----------	----------

NOTE.—May 1 was the day of least tide range. Observations were not attempted, however, because of a heavy SW. wind which disturbed the water in the channel. The morning of the 2d was calm, but on the change of tide the wind came up and gradually increased in strength so that observations had to be abandoned at 1 p. m. The storm blew in full force from 12.30 until 6, and then gradually died away.

The direction of the flood current was exceedingly variable and swung from NNE. to SSW. (Table 4.) The shifting of the flood current and the reversing of its direction are due to the position of Doboy and Commodore Islands with respect to the mouth of Doboy Sound. The incoming flood tide makes up Doboy Sound in a northwest direction and up Back River, lying south of Commodore and Doboy Islands, in a general westerly direction. The flood current coming up Back River meets the mouths of North and Darien Rivers just to the southwest of Doboy Island and is divided three ways—part going up the Darien, part up the North River, and part flows to the NNE. in the channel past Doboy Island. The main flood current making up Doboy Sound is strong enough some two and one-half hours after low water to cause a current to set in a SSW. direction through the channel past Doboy. This set of current, however, lasts only two hours or so, and then reverses to flow in a general NNE.

direction again. As a consequence of this movement of the flood tide, we have the phenomenon of the tide rising at a rate of a little over 2 feet per hour at mid-flood tide with very low and irregular current velocities.

It was also noticed that, due to the configuration of Doboy Island in jutting out into a narrow spit of ballast rock on the southwest corner, many eddies are set up along the western shore of the island. One strong eddy was observed setting in a NNE. direction under the wharf at Doboy at 5.15 p. m., April 24 (Table 4, fig. 18), while the current in the main channel was setting in a general SSW. or S. by W. direction. The eddy appeared to follow the shore line closely and extended only 30 or 35 feet out into the channel. The place of observation appeared to be directly in the center of the eddy, and it is highly probable that this accounts for the zero velocity of the surface current at 5.30 p. m. and the variable velocities found from 3.30 to 7 p. m. Tests with the current meter showed that the eddy was a surface movement that did not extend more than 2 feet below the surface.

CHANGES IN SALINITY DURING THE TIDAL CYCLES

It can be seen from an examination of Figures 12 to 18 that salinity curves follow in general the tidal curves, the minimum salinity occurring about 1 hour after low water and the maximum salinity shortly after high water. On August 30, 1928 (fig. 15), when the river was at flood stage, the surface water was entirely fresh throughout the tidal cycle.

During the normal stage of the Altamaha River, the salinity at neap tides is lower than it is during spring tides, when greater volumes of ocean water enter the coastal region. This can be seen by comparing Figures 12 and 16. On July 3, 1928 (spring tide), the salinity at low slack water was 15.15 at the surface and 15.53 per mille at the bottom; a week later (July 10, neap tide), it dropped to 10.26 (surface) and 11.33 (bottom). Less significant changes were observed at high water. On the same days the salinity at the top and at bottom was 27.95 and 28.75, respectively (July 3, spring tide), and 25.81 and 27.21 on July 10, neap tide. Flood conditions in August and adverse weather conditions encountered in the spring of 1929 prevented further study of changes in salinity during neap and spring tides.

When observations were made in April, 1929, the waters around Doboy Island were just clearing up from the flood of the Altamaha River, which occurred during March, causing the displacement of the salt water in the various rivers with fresh water. The Altamaha River is formed by the junction of the Oconee and Ocmulgee Rivers, both of which originate in the Piedmont Plateau. A river of this class carries down a great amount of silt, which is precipitated upon contact with salt water. The process of precipitation was going on actively in April and May, and the demarcation between the clear, greenish water of the sound and the red, silty water from the Darien River, which is one of the mouths of the Altamaha River, was very apparent. At Doboy Wharf the water was red and silty from an hour after high water to half-flood tide. In Doboy Sound patches of red water could be seen moving toward the sea on ebb tide. The salinity of the water on April 24 ranged from 7.83 per mille at 4 p. m.—approximately 90 minutes after low water—to 26.22 per mille at 9 a. m.—approximately 30 minutes after the morning high water. Samples of water were taken from the surface and from 2 feet above the bottom. At 7 a. m. the surface salinity was 17.21 per mille; at 8 a. m., 22.01; at 9 a. m., 23.78; then it dropped slowly to 9.63 at 3 p. m., 7.92 at 4 p. m., and then rose rapidly to 20.46 at 7 p. m. The bottom salinity was appreciably greater but followed the surface salinity in the form of its curve. For instance, at 9 a. m. the bottom salinity was 26.22, while the surface salinity was 23.78. The difference in salinities was even greater on the flood tide; for example, at 5 p. m. the bottom salinity was 18.64, while the surface salinity was only 8.84. When observations stopped at 7 p. m., the difference between the top and bottom samples ranged from 4 to 6 per mille. These figures show that at the time of the observations there was a good flow of fresh water at the surface of the tidal stream.

SPAWNING AND SETTING OF OYSTERS NEAR DOBOY ISLAND

At the beginning of observations on June 22, 1928, oysters around Doboy Island were ripe, and the temperature of the water was above 26° C. (79° F.) As the spawning of the oyster may occur at any temperature above 20° C. (68° F.), it is possible that oysters began to spawn early in June. The first oyster larvæ (straight-hinge stage) were found in plankton on June 28. It is interesting to note that throughout the season the larvæ were rather scarce and their occurrence in plankton irregular. Quantitative plankton samples were taken at both high and low water from the surface and at the bottom of the channel at Doboy Island by means of a pump, and the water (150 gallons each time) was strained through bolting silk No. 20. There were, unfortunately, numerous gaps in the collections of quantitative plankton samples caused by trouble with the motor which operated the pump. The results of the observations, presented in Table 5, show that the maximum number of oyster larvæ—423 per 100 gallons—was found on July 4. A few larvæ of various sizes continued to be present in plankton until August 9. With the beginning of freshets during the second half of August the larvæ disappeared.

TABLE 5.—*Occurrence of oyster larvæ in plankton*

Date	Number of oyster larvæ in 100 gallons of water				Date	Number of oyster larvæ in 100 gallons of water			
	High water		Low water			High water		Low water	
	Top	Bottom	Top	Bottom		Top	Bottom	Top	Bottom
June 28	0	0	2	0	July 18	6	0	0	0
30	30	[1] 30	0	0	20	100	20	0	0
July 2	----------	----------	43	----------	25	14	0	3	0
4	423	50	7	4	Aug. 4	10	[2] 23	0	0
10	0	0	0	0	9	40	5	-	

[1] 15 umbo stage.

[2] All umbo stage.

First spat was found on July 10 on shells beneath the wharf at Doboy Island, about 1½ feet above mean low water. Setting apparently continued throughout July and August, although the number of umbo larvæ caught in plankton was very small (15 on July 2 and 23 on August 4).

For a study of the distribution of setting, shells were taken at various depths from different localities and examined at regular intervals, and brush and wire bags filled with oyster shells were planted on the flats and on the bottom in the vicinity of Doboy Island and in Duplin River.

Shells taken from below the low-tide mark on the north, south, and west sides of Doboy Island and in Duplin River were found to bear spat of varying sizes; the zone of the heaviest setting was, however, above the low-water mark. On August 31 shells thrown along the shore of Doboy Island were examined by Weatherby, who reports that the heaviest setting (300 to 400 spat per square foot of area covered with cultch) was between 0 and 2 feet above mean low-water mark. In the zone between 2 and 4 feet above low-water mark there were from 200 to 300 spat per square foot. In the zone between 4 and 6 feet above low water there were 50 spat per square foot and no spat were found 6 feet above the low-water mark. Mean low water was taken as the average low-water mark for the period of the survey and corresponded to the 4-foot mark on the tide gage set at the wharf of Doboy Island.

Experiments with wire-bag collectors were carried out at the dock of Doboy Island. Thirty-six bags, 3 feet long, about 8 inches in diameter, and each containing one-half bushel of shells, were used to cover a vertical interval of approximately 5 feet. This was done by first putting two bags on the bottom lying parallel and about 2 feet apart. On top of these two more bags were placed, also parallel and the same distance apart, but at right angles to the first two. Additional bags were added until the stack was of the height mentioned above. The bottom bags were lying on shells and oysters from 1 to 1½ feet below mean low water. The number of spat was obtained by counting those attached to 10 shells picked at random from each bag. Every bag used in the experiment was examined. By September 1 there were, on the average, 15 spat per shell in the zone of 1 to 3 feet above low water; 10 spat per shell in the zone from 1 foot below and 1 foot above low water; and 6 spat per shell in the zone of between 1 and 2 feet below low water.

Oak and sassafras brush, approximately 1,000 bundles in all, were distributed among three places. Four hundred bundles were placed horizontally and extending from 1 foot below mean low water to about 4 feet above mean low water on the mud flat 100 to 150 feet south of the dock at Doboy Island. These bundles were piled to a thickness of about 3 feet. The entire lot was then anchored with rocks and with stakes driven vertically through the bundles. The rocky shore on both sides of this brush and part of the mud flat on which the brush was placed were covered with coon oysters. Approximately 300 bundles of brush were placed on the mud flat at the mouth of North River. These bundles were stuck into the bottom in a vertical position and as close together as they could be placed. Approximately 300 bundles of brush were put out in a layer the thickness of a single bundle in Duplin River from one-half to three-quarters of a mile from the entrance of this river into Doboy Sound. This brush was placed on a comparatively productive oyster reef, and the bundles extended from about 1 foot below mean low-water mark toward the shore for a distance sufficient to cover a vertical interval of about 4 feet. Each bundle was anchored to the bottom by two stakes.

Private interests on St. Simon Island, about 30 miles south of Doboy Island, put out several hundred bundles of brush in a bayou which contained a considerable number of coon oysters.

Each locality was visited twice weekly during the first month after the brush was put out (July) and examined frequently thereafter. At the end of the season only an occasional spat was found on the brush although shells near by caught a fair set.

The observations of 1928 terminated on September 1, when flood conditions prevailed in the region of Doboy Island. They were resumed in April–May, 1929, by Dr. R. H. Luce. The main purpose of these observations was to ascertain the number and condition of oysters caught on the brush planted in the summer of 1928.

BRUSH AS A COLLECTOR FOR OYSTERS

Doboy Island.—The brush set out at Doboy Island in July, 1928, was found on the west side of the island in a little cove about 100 feet south of the wharf. The bank from the wharf to this cove is high and rocky; but as the cove begins the rock bank stops, and the beach turns a little to the east and then runs south as a soft-mud beach. Mixed oak and sassafras brush were placed on the south side of the end of the rock bank as close to the line of the bank as was possible. A few pieces of the brush were 1½ to 2 inches thick at the butt end, but most pieces were small and ended in twigs. The pile was about 10 to 11 feet long, 8 feet wide, 4 feet thick in the center, and about 1 to 2 feet thick at either end. The brush ran from 3 feet below high water to low water (spring tide). The pile was held in place by stakes and weighted down with rocks so that it formed a compact mass which easily supported the weight of a man. At the time of the investigation the brush was covered with slime about one thirty-second inch thick.

Out of the pile only two pieces were found with oysters caught upon them. One was located at the outermost edge of the pile and the second one was midway in the pile. The first piece, 53 inches long, 1¾ inches thick at the base, and three-fourths of an inch at the top, was covered with 121 oysters which were confined to the lower and middle parts of it. The length and width of the oysters averaged 40.3 millimeters ($1\frac{9}{16}$ inches) and 29.5 millimeters ($1\frac{1}{18}$ inches), respectively. The second piece was not removed from the pile, as only 12 oysters could be seen on it.

North River.—Two patches of brush were found at the mouth of North River on the western side of the channel at Doboy Island. One group was about 60 feet from the edge of the marsh and the second about 80 feet and in line with the first group. The locality was a very soft spit of mud which is uncovered at about two-thirds ebb tide, and which rises 2 to 3 feet above low water. The brush was mixed oak and sassafras and was stuck about 18 inches to 2 feet into the mud. The pieces varied from about 2 inches diameter to three-eighths inch at the base, and were placed from 4 inches to 2 feet apart.

Seventeen pieces were pulled from the inshore planting. No oysters were found caught on the brush. The wood was very slimy, and the upper smaller parts were so rotten they broke easily. Two pieces were found to have caught a few barnacles on the smaller twigs.

Twelve pieces were pulled from the second patch. No oysters were found. The brush was very slimy and the upper part broke easily. One piece had caught about 40 barnacles. One large piece of brush, approximately 2 inches in diameter at the base, was broken in several places. No evidence of shipworm infestation was found.

Duplin River.—About 300 bundles of brush, planted in July, 1928, along the western side of the Duplin River about one-quarter mile north of the Coffin Wharf, were laid horizontally and parallel to the shore line at low water (spring tide) for the most part; but at the southern end of the line bundles were laid from low water to high water parallel to the shore line, and a second layer laid over these at right angles to the shore line. At the time of this examination, the line of brush was about 75 yards long, but stakes were visible for another 25 yards at the northern end. It is likely that much of the brush had been swept away during the winter. The pile of brush at the south end of the line was practically covered with mud, so that the lower layer was hardly visible. The effect of this pile apparently was to act as a weir and to cause a heavy deposition of silt at this point. The mud here was 12 to 18 inches deep and apparently had overlaid a shell bank, for firm bottom was found below the mud. The brush running along the low-water mark was mostly from 1¼ to 2 inches in diameter at the base, 4 to 12 feet long, and was composed of mixed oak and sassafras. The brush was either piled very loosely or else many pieces had been swept away during the winter.

In general the catch of oysters on the brush in this region was very good. (Figs. 19, 20.) It was noted that the larger brush was more heavily covered with oysters than the smaller branches and twigs, although a few oysters were found on the latter.

Six hundred and thirty oysters caught on brush were measured for length and width. By referring to Figures 21 and 22, it will be seen that both frequency curves show two well-separated peaks indicating the presence of two distinct classes of oysters: One comprising the oysters of from 3 to 25 millimeters long and 1.5 to 15 millimeters wide (⅛ to 1 inch x $\frac{1}{16}$ to ⅝ inch), and the other class formed by the individuals of from 25 to 70 millimeters long and from 15 to 45 millimeters wide (1 to 2¾ inches x ⅝ to 1¾ inches). The majority of the oysters of the first class were 6 to 8 millimeters long and 6 to 8 millimeters wide, while the majority of the second class oysters were 42 to 45 millimeters long and 27 to 30 millimeters wide. It is highly probable that the smaller oysters came from an early spawning in March, 1929, while the larger ones were undoubtedly those that had set in the summer of 1928.

Of the brush planted in three different localities in the Doboy Island region, one planting (North River) failed completely to catch oysters, the Doboy Island brush caught oysters only on one piece, while the brush in the Duplin River was very successful and caught large numbers of oysters.

The failure of the North River and Doboy Island brush to catch oyster spat during the summer of 1928 can probably be attributed to

FIGURE 19.—Piece of oak brush with 1-year-old oysters. Actual length 50.8 centimeters (20 inches). Duplin River

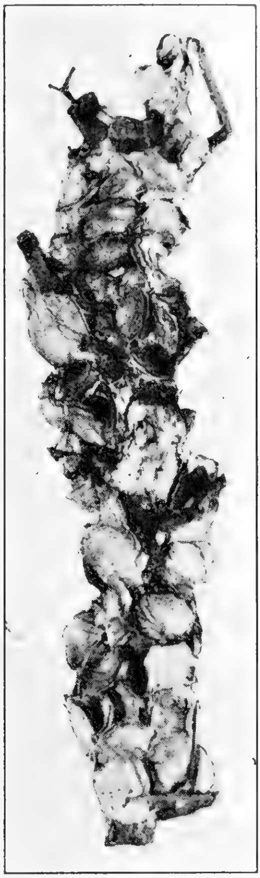

FIGURE 20.—Piece of oak brush with 1-year-old oysters. Actual length 50.8 centimeters (20 inches). Duplin River

the fact that during the freshet that occurred in August, 1928, the brush became covered with slime. Because of the adverse hydrographic conditions in this region at the time of the setting of the oyster larvæ it can not be said that the failure of the brush in these two places to catch oyster spat indicates that it is not a suitable collector for this purpose.

The Duplin River experiments, on the other hand, clearly indicate that oak brush is a very successful collector for oyster spat. In

April, 1929, most of the Duplin River brush planted in the summer of 1928 from low water to 18 inches above low water, was solidly covered with oysters about 4 centimeters ($1\frac{1}{2}$ inches) long. The success of the Duplin River brush may be attributed to the fact that this river is a "dead" river in that it ends in salt marsh and has no supply of fresh water at its head, so that the freshet of August, 1928, probably had but slight effect on this region.

The catch of oysters on the larger pieces of brush was decidedly better than on the smaller branches and twigs, but the counts of oysters on the pieces of brush measuring from $1\frac{1}{8}$ to $1\frac{3}{4}$ inches in diameter have shown that within these limits no one size was better than any other. Whether or not the density of packing of the brush would increase the collecting capacity of the small branches and twigs should be determined by further experiment.

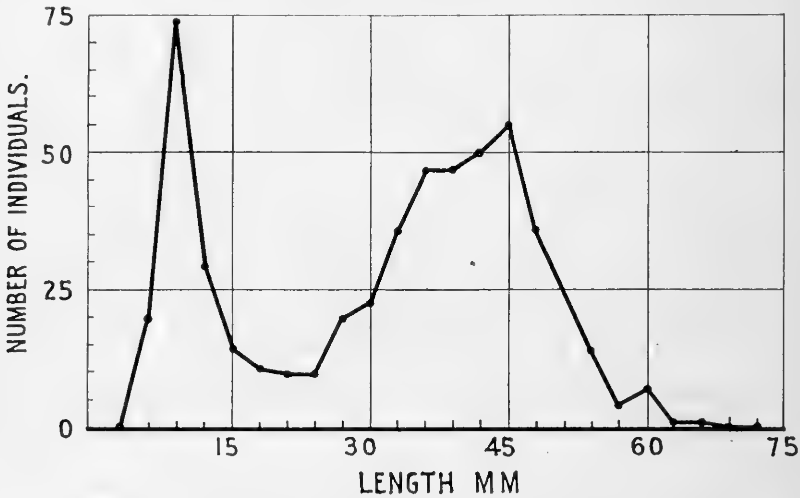

FIGURE 21.—Length of oysters grown on brush, Duplin River, May, 1929

The observations at Duplin River also show clearly that oak brush is far better than sassafras brush of the same size and position. Examination of the whole line of brush failed to disclose a single piece of sassafras brush with oysters caught upon it.

Experiments with various types of collectors planted in the vicinity of Doboy Island have demonstrated that the best results in catching spat can be obtained with chicken-wire bags filled with shells. A full description of this collector and the method of using it is given in United States Fisheries Document 1076, by H. F. Prytherch, 1930. Because of its low cost and ease of handling and transportation, the wire-bag collector must be regarded as far superior to any kind of brush, although the latter type of collector can be used in certain localities where there is a good supply of brush and where it can be obtained at low price.

SIZE OF OYSTERS AT TWO YEARS OF AGE

An opportunity presented itself to examine oysters from brush planted in the summer of 1927 on the south side of North River near the shell spit mentioned above. This place had been cleaned of oysters prior to the planting of brush and, as we know, collected no spat in 1928. In April, 1928, about 200 oysters were collected from 1 to 2 feet below low-tide mark by hand and tongs. One hundred and twenty-six of these oysters were measured for length and width. For the most part they were single and of fine shape, but a few were in clusters of two and three. By referring to Figure 23 it will be seen that the oysters ranged from 55 to 110 millimeters ($2\frac{3}{16}$ to $4\frac{5}{16}$ inches) in length, and from 45 to 90 millimeters ($1\frac{3}{4}$ to $3\frac{9}{16}$ inches) in width. Seventy oysters, or 55 per cent, ranged from 75 to 85 millimeters in length, and 84, or 66 per cent, ranged from 55 to 65 millimeters in width. The frequency-distribution curve for the measurements of these oysters shows a normal form, indicating that all belong to the same year class.

If the above figures are regarded as representative for the whole coastal region, the following estimate can be made of the growth of oysters in Georgia waters: Year-old oysters (based on measurements of oysters from Duplin River): Length, ranging from 24 to 69 millimeters (1 to $2\frac{3}{4}$ inches); width, ranging from 18 to 45 millimeters ($\frac{3}{4}$ to $1\frac{3}{4}$ inches).

Two-year-old oysters: Length, ranging from 55 to 110 millimeters ($2\frac{1}{8}$ to $4\frac{3}{8}$ inches); width, ranging from 45 to 85 millimeters ($1\frac{3}{4}$ to $3\frac{3}{8}$ inches).

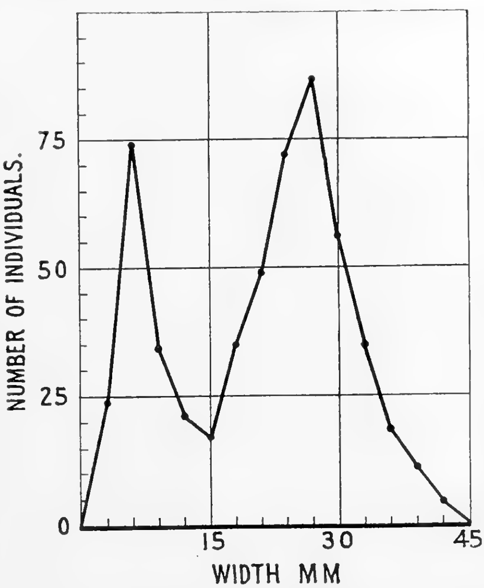

FIGURE 22.—Width of oysters grown on brush, Duplin River, May, 1929

CONCLUSIONS

The survey and experiments carried out in Georgia coastal waters have demonstrated both the advantages and the difficulties in the cultivation of oysters in this region. The present method of exploitation of natural beds, consisting in taking every good-shaped oyster from the tidal flats, leads to gradual depletion of the natural resources. On the other hand, it appears possible by introducing modern methods of cultivation not only to maintain the productivity of the natural beds at its present level but to utilize waste areas of barren bottoms by converting them into oyster farms, thereby increasing the value of marsh land which is unutilized and low priced at present.

What measures should be taken to restore the natural wealth of oyster resources, and what policy should be followed for better exploitation of barren bottoms? We know that most of the natural beds are formed by "coon" oysters of inferior quality, while single oysters of better quality are found scattered about in deeper waters below low-water mark. Bunch or cluster oysters are mostly used by the local canneries, the price averaging from 10 to 12 cents a bushel, while single oysters bring a price of 60 cents to $1 a bushel. It is quite obvious that the best policy is that which encourages the production of the best type and increases the total crop. As the depletion of the natural beds continues, it is necessary to restore and protect them from future destruction. These measures should be taken at once, because the exhaustion of the natural beds leads to a threatening decrease of the annual output. Merely the restoration of the natural beds will not, however, improve the quality of the oyster, nor will it increase considerably the total production. For

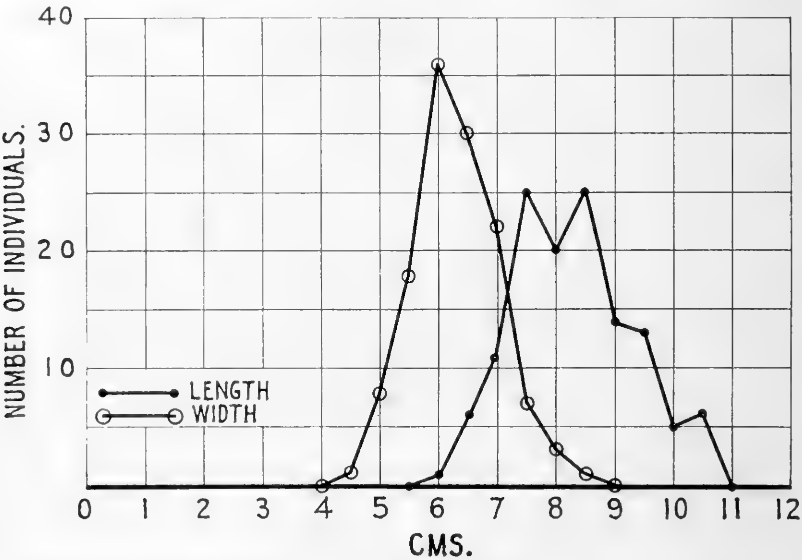

FIGURE 23.—Length and width of 2-year-old oysters grown on brush planted in North River

the two latter purposes the following practical measures should be adopted: (1) The return of the shells to the natural beds from which oysters were taken, (2) the restoration of the depleted oyster beds by the planting of seed or adult oysters, (3) the establishment of oyster beds in suitable localities, and (4) the development of oyster culture.

Return of the shells to natural beds.—Under section 10 of the coastal fisheries law of the State of Georgia, the lessee is required to deposit every year under the supervision of the tidewater commissioner a number of bushels of shells equal to 25 per cent of bushels of oysters taken from the grounds leased. If reasonably enforced, this rule will be of great benefit for maintaining the natural beds and preventing their depletion, provided that the planting operations are carefully supervised so that the shells are planted at the right time and place.

Restoration of depleted oyster beds.—In many localities, the natural beds contain nothing but dead shells, all live oysters having been taken out. These beds can be easily restored by planting seed or adult oysters. In this case the beds should be closed to the public for a definite period of time and efficiently patrolled. Beds of this type are found, for example, along the northwestern shores of the Doboy River, opposite Doboy Island, and in the creek between Doboy and Commodore Islands.

The establishment of oyster beds in suitable localities.—There are numerous localities in Georgia coastal waters where oysters grow scattered on the mud flats. Where the mud is not too soft, these flats can be utilized for the establishment of new oyster beds by the following method: During June and July when the oyster larvæ are free-swimming in the water, spat may be collected on oak brush stuck into the mud between tide marks or on shells in wire-bag collectors placed on tidal flats between 1 foot below and 2 feet above low-water mark. The brush gradually decays or is destroyed by the shipworm and breaks to pieces, so that the oysters fall on the mud forming a new bed. The process can be expedited by breaking the twigs and scattering them over the grounds when the oysters are sufficiently large. Spat collected on shells in wire bags must be scattered on the flats or transplanted below low-water mark.

The development of oyster culture.—The greatest progress of the oyster industry in Georgia can be achieved, however, by the introduction of improved methods of oyster culture, which consists in the following: Setting aside sufficiently large areas suitable for cultivation of oysters; improving the bottoms, by dredging out the accumulation of débris and grass and reinforcing them if necessary by planting shells or gravel; establishing of spawning grounds; collecting of seed oysters on spat collectors (wire bags, brush); transplanting seed oysters on suitable bottoms below low-water mark; and protecting the beds from the attacks of drills and other enemies.

As has been demonstrated by the experiments at Doboy Island, a good set of oysters can be obtained easily in many localities in the coastal waters of Georgia by means of oak brush or wire-bag collectors filled with shells. Seed oysters, upon reaching the size of a half-dollar coin, can be transplanted below low-water mark on firm and unshifting bottoms in the creeks, small rivers, and in the marshes where they will grow and assume perfect form. If necessary, they can be kept there for several years. Although, as our observations of 1928 show, setting may occur in deep water, its intensity is much less than in the tidal zone, and consequently there is little danger that the transplanted seed oysters will become overcrowded with new generations. As the oysters grow larger the extra space is taken up so that it is often advisable to work the beds and remove part of the crop to other grounds. The improvement in conditions for those left on the bed will result in better growth and better quality of the meats. It is believed that by an intelligent application of oyster cultural methods to local conditions, the total output can be considerably increased and the quality of the oysters greatly improved.

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UTILIZATION OF SHRIMP WASTE [1]

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CONTENTS

INTRODUCTION [2]

The utilization of the waste of any industry is desirable because of: (1) The increased profits due to the increased returns from the by-product; (2) the elimination of the disposal problem that is increasingly demanding more attention due to the density of population in the industrial areas; (3) the use of valuable and desirable materials

[1] Appendix VI to the report of the Commissioner of Fisheries for 1930. B. F. Doc. 1078.

[2] The authors wish to acknowledge their indebtedness to W. T. Conn, technologist, and Dr. A. C. Robertson, formerly associate technologist, division of fishery industries, Bureau of Fisheries, Washington, D. C., for their valuable aid in directing the investigation; to R. Clyde Brown and V. Abrams, of the Glynn Canning Co., Brunswick, Ga., for their cooperation not only in providing space, light, and steam, but also for supplying and aiding in the construction of much of the field equipment; and to the chemical laboratories of the Hercules Powder Co. and the Atlantic Refinery, Brunswick, Ga., for their kindness in loaning chemical supplies to tide over the shortages that occurred during the investigation.

that are oftentimes wasted. In the shrimp industry the utilization is doubly important because of the relatively large percentage of waste present, the health hazards caused by careless disposal, and the valuable products that can be prepared from the waste.

At the time of this investigation it appears that only approximately 25 per cent of the waste of the shrimp industry is recovered as shrimp meal, the remainder being thrown away since there is a lack of a simple recovery process which can be profitably adopted at isolated plants and under the condition of widely fluctuating receipts of stock. The primary object of this investigation is the development of one or more processes to utilize the present waste.

The utilization of shrimp waste has been attempted heretofore in one plant at Brunswick, Ga., for the purpose of preparing a fertilizer component. This practice was given up because of the engineering difficulties encountered at this plant during the reduction of the wastes to the form of a fertilizer component. The difficulties were due mainly to the necessity of handling the fluctuating supply of shrimp waste promptly and to the difficulty in drying waste, since the latter often "gummed up" the rotary drivers and stopped operations. If excessive heat was used to reduce this hazard, the waste became partially calcined and carbonized with the loss of nitrogen in the final product and gave off very offensive odors.

From statistics collected by the United States Bureau of Fisheries for the year 1927, the entire catch of shrimp over the territory extending from the northern boundary of North Carolina to the western boundary of Texas amounted to about 100,000,000 pounds.

THE SHRIMP FISHERY [3]

Three marine species of shrimp are taken for commercial purposes. Of these the most important and abundant form is *Peneaus setiferus*, which occurs throughout the range of the fishery from Beaufort, N. C., to Corpus Christi, Tex. The closely related species *P. brasiliensis* is much less abundant and may be distinguished from the other by the characteristic groove along each side of the rostrum which extends nearly to the posterior margin of the carapace, while in *P. setiferus* this groove extends less than halfway back. As the fishermen do not recognize these differences, an estimate of *P. brasiliensis* is difficult. Large specimens of both species (*P. setiferus* and *P. brasiliensis*) are known on the markets as "prawns," or "sprawns," and the half-grown individuals are known as "shrimp." The third species, *Xiphopeneus kroyeri*, commonly known to the fishermen as the "sea-bobs" or "seven-beards," is considerably smaller and differs in color and general appearance; it has a rostrun as long as, or longer than, the carapace instead of shorter as in the species of *Peneaus*. It is taken commercially only on the Louisiana coast, where it is used for drying when the larger species are unobtainable.

The irregularity of the movements of the shrimp makes it difficult to define the seasons of abundance in the various waters. In general,

[3] Material in this section is largely drawn from the Report of the Commissioner of Fisheries for 1917, pp. 7–8.

the season in North Carolina is August to November; in South Carolina, July to November; in Georgia and east Florida, the year round, with irregular slack periods; in western Florida, October to July; in Mississippi, March, April, and July to December; in Louisiana, February to May and July to November; in Galveston Bay, Tex., March to November; and in Corpus Christi Bay, Tex., throughout the year with longer or shorter periods of slackness.

On the Atlantic coast the bulk of the shrimp is taken with trawls. At Appalachicola, Fla., and Biloxi, Miss., the otter trawls have been recently introduced and are expected to play an increasingly important rôle in the shrimp fishery of the Gulf coast. In the trawl fishery, motor boats with crews of 1 to 3 men are employed. In the Mississippi haul-seine fishery, sailing schooners about 40 feet long serve to carry the fishermen to the fishing ground, which is 25 to 80 miles distant, and to return the catch to the factory. In operating the seine a motor boat and a rowboat are used. The seines range from 175 to 250 fathoms in length and 11 to 18 feet in depth, and are operated by crews of 6 men. In Louisiana the fishermen establish camps near the fishing grounds, the latter being visited in open motor boats.

The otter trawl used in the shrimp industry varies in width from 22 to 75 feet, the length being about one-fourth greater than the width. The wings are from 3 to 5 feet in length. Cotton netting is used, supported by tarred cork and lead lines. A buoy is attached to the bunted tail, which insures recovery of the net should it become torn loose from the tow lines. The mouth of the net is held open by otter boards of 1-inch plank of suitable length.

The trawl is generally operated from cleats amidship of the boat and is towed at 2 to 5 miles per hour for about 30 minutes for each haul.

Trawling brings a greater revenue to the fishermen as the average catch per man per day is considerably increased. This was particularly important during the war while the shortage of labor was acute, as 1 or 2 men could often take the place of 15 or 20. Furthermore, up to the advent of the trawl, the adult of the *P. setiferus* was unknown as an article of commerce, as they seldom came within seining distance of the shore. On the other hand, at a depth of 1 fathom to about 10 fathoms and a distance off the shore of about 18 miles, there has been opened by the use of the trawl an immense fishing ground where a bounteous supply of the adult shrimp usually exists. This new supply offers favorable possibilities for the future of the shrimp industry. The disadvantages of the trawl must not be overlooked, however, for at certain seasons of the year, when small shrimp are abundant in inside waters and when they are traveling through the deeper bayous, they can be destroyed in considerable quantities by selfish fishermen. This fault, however, is not inherent in the device itself as shrimp show a mutual tendency to separate themselves into schools of uniformly sized individuals, and when seines and trawls operate side by side the average size of the shrimp caught is always identical.

THE SHRIMP INDUSTRY

HANDLING SHRIMP ABOARD VESSELS AND AT THE WHARF

Unless the shrimp are iced or cooled immediately when caught, they will soften quickly, especially in warm weather. Because there is danger of such softening, shrimp boats or trawlers carry plenty of ice. Shrimp buyers refuse to take stock that is not in good condition at the dock. Heavy icing is particularly important when the shrimp are molting because they are soft, easily broken in handling, and more subject to decomposition.

Care in handling shrimp begins the moment the net is raised. All soft, damaged, or small shrimp are culled out and the slime and dirt removed by thorough washing with water. Culled and cleaned shrimp are stored in the hold of the boat at once with ice. As soon as the boat reaches the dock the shrimp are removed from the hold and sorted a second time. Steel baskets holding about 100 pounds of shrimp each are lowered to the boats by means of a derrick operated by power. The shrimp are loaded into the baskets with shovels or dip nets; the baskets are then hoisted to the wharf, where they are weighed.

If to be stored for a short time they are placed in an ice box which is about 12 feet square and 7 feet high, just off the picking room. It is built with double, insulated walls in refrigerator fashion, with a door on the side. Chopped ice to the depth of 4 inches is first spread on the floor, followed by a layer of shrimp about 6 inches deep. Between each layer of shrimp there is a layer of ice 2 inches deep, but on the top layer of shrimp there is another layer of ice 4 or 5 inches deep. Every day there is a fresh supply of ice thrown over the top. These ice boxes can be chilled down to about 40° F. In hot weather the shrimp can not be kept in the ice box longer than 2 or 3 days without spoiling, but in cold weather they are frequently held for as long as 8 or 10 days, waiting for the accumulation of a supply large enough to justify packing operations.

For short-time storage some dealers place the shrimp in tubs of water filled with crushed ice, whereby the temperature is held in the neighborhood of 40° F.

PREPARATION OF SHRIMP FOR MARKET

Removal of the head, which is known as "heading" and which is accomplished by breaking the head and thorax from the tail portion, is done either before or after the shrimp are iced, depending upon the amount of the shrimp on hand. If the amount on hand is larger than can be taken care of immediately by the "heading" crew the surplus is iced; otherwise the heads are removed as soon as the shrimp are landed. Heading is done for most of the iced fresh shrimp that are sent to inland markets or for preparing the pickled "keg stock." It is essential that the shrimp be headed before they have become warm, because the dark liquid in the stomach of the shrimp consists of oily, partially digested plant and animal matter, which readily decomposes. This liquid, as well as the body slime, must be removed immediately after the shrimp are headed by washing the headed shrimp in iced or fresh water three or four times, dipping from one iced tub to another. In certain sections the trade demands the headless stock. In other markets, especially in the South, consumers are suspicious of headed shrimp as they erroneously regard the absence of the head as an indication of spoiled stock. Such consumers ultimately pay the express on the entire weight of the package and then throw nearly half of the shrimp away. Experiments indicate that the heads and appendages constitute from 43 to 45 per cent of the whole raw shrimp.

The shrimp are kept in the ice box for two or three days to facilitate the removal of the appendages in the peeling operation. This removal of the desirable fleshy portion of the tail from the shell, head, and thorax is done on the picking tables in the sheltered portion of the wharves.

The pickers stand on either side of the table facing each other. Each one is supplied with a round bucket made of galvanized metal, perforated both sides and bottom with round holes about one-half inch in diameter, and having a capacity of about 7 pounds of shrimp meat. Each picker is supplied also with a bucket or can of alum water into which the fingers are dipped from time to time to offset the action of the alkaline secretions from the body of the shrimp. Without the use of the alum water, the pickers' fingers would soon become so sore from the action of these body fluids that they would be compelled to abandon their work. The meat buckets and the alum water buckets are placed on the edge of the table outside the trough. A shrimp is taken in the left hand, palm downward, being held by the tail or the body portion, the legs pointing toward the body of the picker and the head pointing toward the right hand of the picker. The head of the shrimp is first seized between the thumb and the two first fingers of the right hand and broken or twisted off. The right thumb is now thrust between the right and left rows of legs, breaking open the shell by running the thumb under the shell and around the body, peeling off a section of shell an inch to an inch and one-half in length. By squeezing the tail end of the shrimp between the fingers and thumb of the left hand the meat is forced from the shell and allowed to drop into the meat bucket.

The heads and shells are dropped upon the edge of the table; and when a small pile accumulates they are pushed from the table into wooden boxes placed on the floor at the pickers' feet, or upon the floor to be raked up later and disposed of by an attendant who carries the boxes to the end of the wharf where they are gone over for any whole shrimp that the pickers carelessly throw away; the waste is then dumped overboard. If the picking room is above the water the waste is dumped directly into the tide water. The whole shrimp which are recovered are returned to the picking room. When the shrimp are running small in size, there is a considerable quantity of whole shrimp thrown out by the pickers. The manager ignores this when the size of the shrimp is small. When the shrimp are large the careless one is found and cautioned for the carelessness.

The pickers consist principally of women, boys, and girls, both white and black, the two races always working at separate tables. Sometimes colored men will be seen working at the picking tables, but seldom, if ever, white men. The picking operations, when a large supply of shrimp is on hand, usually begin about 4 a. m.

The picking rooms are about 75 feet long and 40 feet wide. The picking tables are each about 18 feet long and 42 inches wide, being made of 6-inch planks held together by wooden cleats on the under side. The middle portion of the table, about 21 inches in width, is inclosed by 4-inch planks set on the edge and running the entire length of the table. This forms a trough in the middle of the table which holds a supply of shrimp for the pickers. The main object of the 4-inch planks, however, is to supply a support for the steel baskets in which the shrimp are unloaded from the boats. The basket full of shrimp, after being brought to the table, is turned over on its side, with the weight of the basket resting on the side of the trough and the shrimp falling into the trough in the middle of the table. The basket is rolled along on the edge of the plank, distributing the shrimp as it goes, the plank preventing the weight of the basket from rolling on the shrimp and crushing them. There is a space of about 10 inches in width on the side of the trough of the table on which the pickers place their buckets.

The pickers are paid by weight. The rate at which they are paid depends altogether on how the shrimp run as to size. In practically every lot there will be some shrimp of every size; but in some lots the larger ones predominate, although there are times when a particular lot of shrimp will be almost uniform in size throughout. Before picking operations begin, the foreman sizes up the shrimp and then announces to the pickers the number of pounds of meat for which 5 cents will be paid. This ranges during the season from 5 to 6½ pounds, the smaller weight being required when the shrimp are small. Most of the picking is done at the rate of 6 pounds of meat for 5 cents, although there is no hard and fast rule governing the various prices. The average picker will make, on a full day's run, about $1.50. A few of the expert pickers have been known to make as high as $2.50 per day.

PACKING SHRIMP FOR MARKET

Shrimp are packed for the market in the following conditions: (1) Raw whole shrimp, (2) raw headed shrimp, (3) headed cooked shrimp, (4) cooked shrimp meat, (5) canned shrimp meat, (6) dried shrimp meat, (7) shrimp paste.

All shrimp except those shipped in the raw state are brine cooked, the concentration of the brine, time of cooking, and conditions after treatment such as drying, cooling, rebrining, etc., depending upon size and conditions of shrimp and condition of the market.

Raw whole or headed shrimp.—Raw whole or headed shrimp before being packed are chilled to 40° F. or below. A layer of ice is placed on the bottom of the barrel provided with drainage holes. A layer of chilled shrimp is placed on the ice, then another layer of ice, and then another layer of shrimp. A large cake of ice, called the "header," is placed on top of the barrel. Another method is to provide a bottom layer of ice and then place on end a long narrow cake of ice. The shrimp are packed around this cake, or core, of ice; the "header" cake is placed on top of the barrel; and the barrel and its contents are covered with burlap. In the case of raw shrimp, car lots of iced barrels occasionally may be sent by fast freight in refrigerator or ventilator cars.

Headed cooked shrimp.—After removal of the heads, the stock is cooked in a brine containing from 10 to 25 per cent salt for 15 to 20 minutes. The brine should be boiling when the stock is immersed; at least 4 gallons of brine should be provided for each 10 pounds of stock, and evaporation compensated by addition of hot water, the percentage of salt being controlled by a salimeter. The stock must be completely immersed. A minimum of salt will produce a minimum of shrinkage in the stock and is satisfactory when shipping to near-by markets in cool weather. For shipping long distances a 15 per cent salt solution should be used. After the cooking the stock is thoroughly chilled to below 40° F. For shipping short distances in cool weather, the stock may be packed without ice in lots of not over 30 pounds. For shipping long distances the stock is packed in 1 to 5 gallon cans and shipped in ice.

For shipment without ice headed cooked shrimp are sometimes packed in kegs in a brine of 15 to 20 per cent strength. This "keg stock" keeps well and is used in the restaurant trade where proper time can be allowed for freshening the shrimp before use.

Cooked shrimp meat.—Shrimp meats from the picking operation are cooked in a moderately weak brine for several minutes; the character of brining and cooking is determined by the market to be served. The cooked meats are spread thinly upon wire racks for cooling and partial drying. After being thoroughly chilled to 35° F. they are packed in parchment-lined cans holding about 1 gallon and shipped in ice.

Canned shrimp meat.—The stock from the picking tables is boiled for 4 to 5 minutes in a brine containing about 1 pound of salt in 1 gallon of water. The cooked meat is drained and cooled on wire racks, and weighed amounts are packed by hand into glass jars or parchment-lined cans, either in the natural condition or in a weak brine. Complete filling of the container is avoided in order to forestall crushing of the meats. The containers are exhausted, sealed, and thoroughly processed. It is good practice to inspect the pack after a few days' storage before sealing in shipping cases.

Dried shrimp meat.—The whole shrimp are boiled in a weak brine; the character of the cooking is dependent upon weather conditions. The cooked stock is spread in a layer not exceeding 3 inches in depth upon wooden platforms where it is dried by solar heat. Provision is made for protection against inclement weather. The dried stock is threshed to separate the meats which are packed in 5-pound heavy paper bags, and then 20 of these are placed in a burlap bag.

The dried refuse is ground to shrimp meal and constitutes a large proportion of this material now on the market.

Shrimp pastes.—These are made by rubbing the cooked shrimp meat into a smooth paste to which is added condiments which tend to preserve the paste as well as add to it a desirable flavor. The paste is packed in metal tubes. It is used largely for sandwiches and as a relish.

TYPES OF SHRIMP HANDLERS

There are two main types of shrimp handlers: (1) The independent dealer who prepares a small amount of iced fresh heads for the market; and (2) the canneries, which not only sell iced headed shrimp for immediate use but which also, in the seasons of the heavy hauls, hermetically seal the shrimp in the various styles of containers. The former have very little money invested in the plants while the latter vary in the equipment according to the class of the work carried on at the cannery. The canneries often use their plants to preserve vegetables, oysters, and other sea foods. The utilization of shrimp waste constitutes a different problem with these two types of handlers.

Independent dealers.—Usually a dozen or more independent dealers are located in buildings close together, the buildings consisting of nothing more than warehouses wherein the shrimp are headed, iced, and barreled; where the nets are stored and mended; and where also is located a little office. On the east coast a small group, generally Portuguese or Norwegians, in very infrequent cases Americans, group together and pool their catches for shipment from the

FIGURE 1.—Group of prawn boats belonging to fishermen supplying small shrimp holders

same plant. Figure 1 shows a view of shrimp boats massed at the dock at one of the southern water fronts. These belong to independent fishermen who supply shrimp to a group of independent plants. Control of shrimping practices needs to be exercised in such cases, owing to the laxity that these men take toward maintaining a degree of cleanliness on the outside of the buildings. Waste shrimp left by the receding tide is almost always found underneath the buildings and on the banks and at the sides of such plants, and seldom efforts are made to wash them away. The easily putrefiable shrimp waste soon gives off very offensive odors which attract the flies. The amount of waste available from each of these plants is not considerable, varying with the season and the catch, but at all times odors are present. A pooling of interests among these men to utilize the wastes could be practiced and carried out without additional help or probably with the assistance of a trained additional man who can take care of a dozen or more plants. This would increase their revenue and also eliminate the nuisance.

Canners.—The canning of shrimp is a factory operation involving a considerable investment in equipment, machinery, and buildings. Administrative ability equivalent to any other manufacturing operation is required for success. Many operators, by adding specialized equipment at small extra expense, are able to utilize the factories and stabilize labor by canning oysters, fruit, and vegetables when shrimp are not available. While the canners supply unsealed package goods to fresh fish markets, a considerable proportion of the stock is processed in sealed glass jars and cans for distribution through wholesale grocers. The plants are generally located in close proximity to independent dealers, although many are located in isolated localities.

SOURCES OF SHRIMP WASTE

The canners of large and small quantities of shrimp look upon the utilization of any wastes as a business proposition, considering the fact that 43 to 45 per cent of the shrimp that is ordinarily thrown away must be handled on the boats, be properly iced, handled at the docks, put on ice or in a refrigerator, handled by the headers and the peelers, and then quickly disposed of to prevent putrefaction and fly infestation. A condition where operators pay $60 per ton for shrimp, then throw overboard products for which $27 was paid, is one deserving careful attention.

In addition to the waste from the heading operation there are available shrimp that have become softened and discolored by improper handling and also those very small shrimp which can not be economically handled for canning or which can not be marketed as fresh shrimp. When the supply of shrimp becomes excessive, the minimum size of the shrimp that the canneries will take becomes larger, and thereby the amount of small or "undersized" shrimp available as waste is increased.

The portion of the shrimp which constitutes the waste is 43 to 45 per cent of the weight of the shrimp. The extent to which this material is utilized is relatively small, varying with the locality. It is used green or raw for fertilizer, and in the dried form as shrimp meal. In 1928 the amount of shrimp meal produced was 1,726 tons valued at $58,080.

The installation of very little equipment, in some cases nothing new or additional, will be required to convert this valuable shrimp by-product into a desirable cattle feed. In 1927 the total amount of shrimp caught on the eastern and southern coasts of the United States was about 100,000,000 pounds. About half of this weight was thrown overboard as waste. The conversion of this material into commercial by-products would have paid the industry funds which are at present realized only partially.

Furthermore, where the shrimp handlers are located in or near a city or settlement, the throwing of the shrimp into the streams or tidal water constitutes a nuisance that should be avoided. Already laws are in force preventing the throwing of shrimp waste into the waters of the trawling grounds and further legislation should be directed against the promiscuous casting of this easily putrefiable waste where drainage and tidal washes do not carry it away.

PRESENT USES OF SHRIMP WASTE

Chemical analyses and experimental studies indicate that the waste is a valuable product, convertible into several types of material. (1) Shrimp meal has been on the market for some time as a fertilizer; this product is prepared from the dried waste from the shrimp drying process as well as from the waste from some canneries. (2) Raw shrimp waste is used by the truckers and farmers who live near the canning plants. There is some hesitancy about the utilization of the green waste because of the fly infestation that accompanies putrefaction. As a result of this fly infestation there is a considerable loss of nitrogen. (3) The presence of bone phosphate, proteins, fats, and iodine in shrimp meal makes it a valuable concentrated feedstuff when the material is processed to bring it into a condition palatable to animals.

THE PROBLEM

Recent developments in medicine have included the demonstration of the necessity of iodine for the human system, especially as a corrective for goiter conditions and to assist in the prevention of goiter among the inhabitants of the so-called "goiter belt" of the Middle West.

In a study made by Tressler and Wells[4] it was pointed out that among the mollusca and crustacea are found those organisms bearing the highest iodine content of all sea foods, for these animals average between 2,000 and 11,000 parts of iodine per billion. The lobster has an iodine content of 11,600 parts per billion on the water-free basis; oysters, 6,000; clams, 6,200; and shrimp, 2,250.

The medical profession has prescribed various iodine-bearing substances for the human being but up to the present time no great effort has been directed toward finding a corrective article of diet for cattle. A search of information concerning feedstuff shows that little of this material contains iodine in marked quantity. In investigating possible sources of the iodine supply available for stock feeds, the sea foods present themselves as a possibility, but the heavy demand for the usual sea foods makes them prohibitive in price as possible sources of this valuable ingredient. Attending the preparation of sea foods for the market there is always a considerable waste, the amount varying with the nature of the fish or shellfish in question. It is from this source of material that one may expect to derive feedstuff in the form of meal that would contain the valuable and desirable iodine, together with protein, necessary for cattle feedstuff, for the goiter belt of the United States.

Among the shellfish, the shrimp is the fourth highest iodine-bearing sea food, headed by oysters, clams, and lobsters. The shrimp lends itself admirably to utilization for the above purpose, since from 43 to 45 per cent of the whole shrimp becomes waste material in the canning of this sea food. Analysis of the shrimp meal prepared from the wastes of dried shrimp show about 2,000 parts per billion of iodine. In addition to this the meal contains a

[4] Iodine Content of Sea Foods (with bibliography) by Donald K. Tressler and Arthur W. Wells. Bureau of Fisheries Document No. 967. Appendix I to Report of Commissioner of Fisheries for 1924.

maximum of 9 per cent nitrogen, and a minimum of 2 per cent phosphorus calculated as phosphorus pentoxide.

In order to produce meals, the handler of small quantities of shrimp would have to invest in additional cooking equipment, a small drier, a feed grinder, and a small building to house the equipment. The size of the equipment would depend upon the maximum quantity of shrimp waste available in one day. By pooling interests, a number of small handlers could go together and erect a reduction plant and operate on a cooperative basis, assuring a larger supply of raw material and cutting down overhead for the utilization of the waste for the production of stock feed.

The additional equipment necessary to reduce the peeled shrimp waste to meal in the large shrimp canneries would not be as extensive as that necessary with the small handlers. The peeled shrimp wastes should be treated in different vats from those used in the canning of shrimp meat, but the utilization of waste heat and auxiliary equipment in such plants would make the handling less expensive. The large canners could vary the size of the equipment, dependent upon the amount of the shrimp handled.

PRESENT INVESTIGATION

The United States Bureau of Fisheries established a field laboratory at Brunswick, Ga., during the summer months of 1928, to investigate the shrimp-waste utilization problem. Studies on the chemical composition of raw shrimp wastes and treated shrimp wastes together with field studies of various methods of treating wastes for the production of fertilizer, and poultry and stock feeds were undertaken by the writers.

Analytical determinations were made according to the standard practice. The iodine evaluation was made according to the method of von Fellenberg as modified by Tressler and Wells.[5]

The commercial utilization of shrimp waste that has been produced up to this time has been confined to a component of fertilizer or to direct application to the ground, except for considerable quantities which have been sold for fish food.

The analysis of shrimp meal and two minor feeding tests conducted by the United States Department of Agriculture several years ago indicate that it might well be considered as a component of feedstuff as well as for fertilizer.

An essential feature to be remembered in the use of shrimp meal as a protein concentrate for poultry feed, as differing from stock feed, is that the content of added salt (NaCl) must be kept at a minimum. An increased percentage of salt is allowable in a swine feed and still more for dairy feed. All feeding material should be produced under sanitary conditions; fertilizer may include material the quality of which renders it unfit for feeding to animals.

Experimental shrimp meals produced according to the processes or methods of production described in the following are excellent materials for fertilizer stock. As far as their diversion into the field of animal nutrition is concerned, it should be carefully noted that

[5] Iodine Content of Sea Foods (with bibliography) by Donald K. Tressler and Arthur W. Wells, Fisheries Document No. 967. Appendix I to Report of Commissioner of Fisheries for 1924.

the feeding value of these meals has not been tested as yet, and that until such experimental feeding tests are conducted to determine their feeding value, the Bureau of Fisheries does not recommend them for such purposes.

However, experts and animal husbandrymen of the United States Department of Agriculture, after carefully observing the chemical analyses of these experimental meals as listed in the tables contained in this publication, and after observing samples of the experimental meals, are of the opinion that they offer promising possibilities in animal feeding and recommend that feeding experiments be conducted to determine their suitability in animal nutrition.

PREPARATION OF EXPERIMENTAL MEALS HIGH IN SALT CONTENT

BRINE-COOK METHOD

Collection of the waste.—The shrimp waste available from the heading and picking tables is collected into wire baskets made on 2-pole supports or with standards that will support the baskets in the cooking vats. The baskets should be made with heavy galvanized stock with about 4 to 9 meshes per square inch. The shape of the baskets depends upon the shape of the cooking vessel. The size of the baskets is also influenced by the size of the cookers, allowing sufficient extra space in the cookers to permit natural agitation of the brine-suspended waste. The waste weighs approximately 40 pounds per bushel. It is necessary to use shovels in handling the heads since the spiny ends of the shrimp cause great pain if they become lodged in the skin. This procedure for the collection of the waste was followed in all the methods discussed for its utilization.

Cooking.—The shrimp waste collecting baskets also serve as dip baskets in the cooker. The vat is filled sufficiently full to prevent " boiling over " when the baskets are suspended in the brine. To the water is added salt varying from 2 per cent to 12 per cent of the weight of the stock; with higher concentration of the brine, more salt is retained in the cooked heads. Such material is more stable toward spoilage than the nonsaline cooked heads. The exhaustion of the salt in the cooker is not rapid, but additional salt should be added from time to time to maintain the proper saline concentration. After suspending the baskets in the brine, the solution is brought to a boil and allowed to boil actively for 10 minutes. Longer time does not harm and has no beneficial results if the shrimp waste is handled properly. After cooking it is removed from the cookers by lifting out the baskets.

Drying.—The cooked waste is removed to a drying shed or cooling platform and spread out in a layer of not over 3 inches in thickness; if the supply is small the spreading can be made much thinner. The heated waste cools, and a sufficient amount of water evaporates off to bring the moisture concentration to below 50 per cent in a few hours. In this condition the waste is semipreserved and can await handling in the drier until the next day. If the weather is very dry and the cooking is done early enough in the day to get the benefits of the midday's sun, with active turnover, the moisture content can be reduced to about 20 per cent on the same day. Waste holding this amount of water is a stable product, but the high moisture content causes difficulty in grinding. If platform drying of shrimp waste in wide trays is used the trays can later be transferred to the drying oven or tunnel. If reduction down to 20 per cent only is desired and the stock is small, flat wooden boxes or trays can be used and the turning of the stock accomplished by inverting one tray over another.

The type of drier that should prove most satisfactory to the shrimp handler is the shelf drier. (See fig. 2.) This can be constructed of sheet iron to reduce the fire hazard and made with riveted cleats upon which to slide the drying trays. By making the drier long enough to permit the staggering of the trays, a long tortuous path for the heat is provided in passing over the stock and greater efficiency of drying is accomplished than when the trays are arranged otherwise. The heating can be accomplished by using oil stoves, which permit easy control of the flame. The cost of drying stock with kerosene is one-third of a cent per pound of the dry stock. Drying to crispness brings the moisture content down to about 6 per cent. The dried material is now ready for grinding.

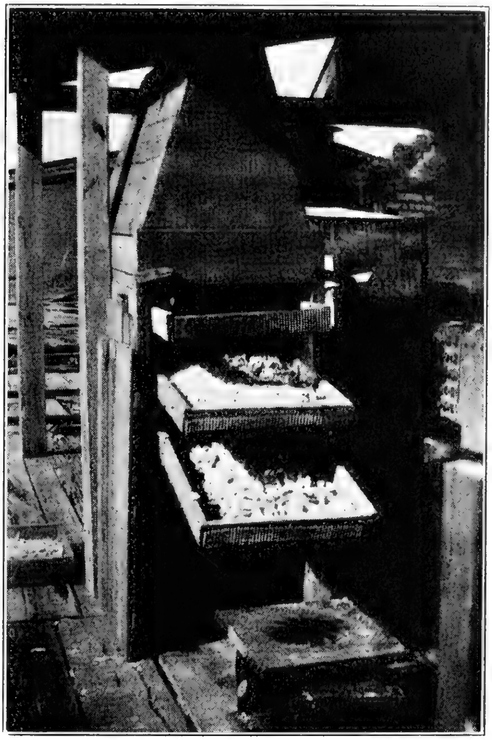

FIGURE 2.—End view of wooden shelf drier using staggered trays and oil stove

Grinding.—The nature of the dried waste requires a disintegrator type of grinder for the most efficient reduction, although other types of grinders will give satisfactory service. The feed or grain mill with adjustable rotating disks can be utilized to great advantage by making the grinding operation in three stages, viz: Coarse, medium, and fine adjustment. After the material is run through the grinder with the disks at coarse adjustment, the material is returned to the grinder, reduced with the adjustment at medium grade, and finally reground to fine meal. A series of three grinders set at the three grades, the second and third grinders fed by the first and second, respectively, will eliminate handling between stages of grinding. If the latter system is used, the size of the grinders should be varied so that each succeeding grinder adequately handles the meal delivered to it from the preceding grinder. Grinding the stock just after delivery from the driers facilitates the pulverizing operation. This product when dried below 7 per cent moisture is easy to grind into a very fine meal.

Yield and chemical analysis.—By the above method yields of approximately 600 to 700 pounds per ton of the raw waste are possible. Typical analyses and yields of some special meals prepared by the above process are given in Table 1.

TABLE 1.—*Chemical composition of experimental meals prepared by the brine-cook method*

Items	Per cent concentration of salt in cooking brine on basis of weight of raw shrimp				
	2	5	7	12	12
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Yield	29.0	25.0	30.3	33.8	37.3
Moisture	9.3	9.8	15.7	5.6	6.3
Proteins (dry basis)	37.0	54.8	49.3	42.7	43.3
Ether extract (dry basis)	1.9	2.6	3.5	.9	.4
Calcium phosphate (dry basis)	4.9	5.5	5.7	6.8	7.1
Sodium chloride (salt, dry basis)	7.7	12.4	19.9	20.8	17.5
Calcium sulphate (dry basis)	2.0	.9	2.0	.3	.3
Iodine ..... parts per billion	6,400	6,700	7,100	4,400	7,600

NOTE.—Owing to the high salt content indicated in the analyses shown in Table 1, meals produced by this method, if the product shows an analysis of salt content similar to the above, should not be fed in greater proportions than 10 per cent of the total ration of the animal. According to animal husbandrymen of the U. S. Department of Agriculture, 2 per cent of salt in the total ration is sufficient for the dietary needs of cattle, 1 per cent for swine, and 1 per cent for poultry. More than these amounts for the respective animals might produce deleterious results.

WASTE BRINE-COOK METHOD

After cooking the shrimp meat in the canning operation, the brine solution becomes milky and unfit for further use in this operation. This liquor is now run to waste in the shrimp canneries. It contains about 12 per cent salt and 0.9 per cent coagulable protein. This solution as it is, or diluted to reduce the salt concentration, can be used for the stock solution in which the shrimp waste is cooked. After the proper length of cooking, the baskets are removed, and a fresh supply of shrimp waste is suspended in the brine solution.

Considerable albuminous matter remains in the waste liquor and cooking the heads in this seems to retain much of the original protein content of the treated waste. A series of experimental meals was made by using waste cooking vat liquor as a boiling medium. The products obtained were analyzed and the results recorded in Table 2. Note that they contain considerable quantities of salt.

TABLE 2.—*Chemical composition of experimental meals prepared by the waste brine-cook method*

Item	Batch 1	Batch 2	Batch 3	Batch 4
	Per cent	*Per cent*	*Per cent*	*Per cent*
Yield	37.3	33.8	34.9	39.0
Moisture	6.3	5.6	5.2	8.4
Proteins (dry basis)	43.3	42.8	40.7	41.3
Ether extract (dry basis)	.4	.9	1.6	1.7
Calcium phosphate (dry basis)	7.1	6.8	7.0	6.8
Sodium chloride (salt, dry basis)	17.5	20.8	22.8	20.8
Calcium sulphate (dry basis)	.3	.3	.3	.3
Iodine ..... parts per billion	7,600	4,400	7,300	4,700

NOTE.—Owing to the high salt content indicated in the analyses shown in Table 2, meals produced by this method, if the product shows an analysis of salt content similar to the above, should not be fed in greater proportions than 10 per cent of the total ration of the animal. According to animal husbandrymen of the U. S. Department of Agriculture, 2 per cent of salt in the total ration is sufficient for the dietary needs of cattle, 1 per cent for swine, and 1 per cent for poultry. More than these amounts for the respective animals might produce deleterious results.

PREPARATION OF EXPERIMENTAL MEALS LOW IN SALT CONTENT

The conversion of shrimp wastes into meals low in salt entails more labor than the conversion of wastes into fertilizer, a procedure which will be described later, but the processing is cleaner and the returns on the product obtained are so much greater that it becomes the more economical method of utilizing the wastes. There are two general methods of treating the shrimp heads, (*a*) nonacid water-cook and rapid drying and (*b*) acid water-cook and drying. The first method gives a product low in soluble sulphates, while the latter gives a sulphate content dependent upon the amount of acid added to the cook. The first requires no acid, but the drying or reduction of the stock to about 40 per cent moisture content must be carried out the same day that the shrimp are headed to prevent spoilage. The second requires care in adding acid, but the product with as high as 60 per cent moisture will not decompose for a period of two days.

NONACID WATER-COOK METHOD

Cooking.—The shrimp waste is collected in 2-poled wire baskets of 50 to 100 pound capacity and carried to the community plant serving the group of small shrimp handlers. Here the baskets are lowered into a cooking vat steam heated, or heated by direct fire. A large iron kettle will give satisfactory service but in that case the baskets must be so constructed as to fit the circular kettle, ample space being allowed around the basket to permit ready circulation of the boiling water. The vats to be used for cooking shrimp wastes can also be built of heavy timber, in square or rectangular shape to accommodate the baskets used in carrying the shrimp. The shrimp wastes are loaded into wire baskets of a type similar to those used in the cooking of the shrimp meat. These baskets are carried into the waste shrimp cooking rooms and suspended into vats, where they are left for 10 minutes after the water in which they are suspended reaches the boiling point, or 212° F.

Solar drying.—The cooked waste, now quite pink in color, is carried to a drying platform or dumped onto wire bottom frames to allow free circulation of air through the mass. In this manner the sun will evaporate the moisture. Tray drying is shown in Figure 3. These trays can be so constructed that they can later be transferred to a heat drier. If the sun is shining, the frames may be placed in the sun and the drying started. The period of drying by solar heat depends upon the thickness of the mass upon the screens, the time of day, and the sequence of hours of sunshine. In good sunshine, and with a layer not over 3 inches thick, drying of the product to 10 per cent moisture content is readily accomplished in 8 hours. A product with as high as 15 per cent moisture may be stored several months or more without spoilage. This product can be accumulated and further dried in a heated drier, when sufficient stock is on hand, and then ground at leisure, or in the off season for shrimp. The final drying should be carried below 8 per cent in moisture, the best product for efficient grinding containing about 5 per cent moisture.

Rapid heat drying.—In inclement weather and for the final drying, the stock must be placed in heated driers. The type of drier to use is one that permits ready circulation of hot air and gases among the mass of whole heads and whole peeled shrimp waste. The direct externally heated rotary drier should be avoided because the stoppage of the drier would permit burning which would make the product unsalable. The shelf type or tunnel drier, as shown in Figure 2, would require the least power equipment and would give a satisfactorily dried product. In all cases such driers should be on hand to reduce the sun-dried stock to 5 per cent moisture content. The drier built of sheet steel with removable shelves of steel plates is inexpensive and quite flexible and is able to handle either a large or small amount of stock. Sliding trays can be arranged so as to provide a zigzag course for the heat to pass under and over the trays. The drying process is conducted by removing the lower dry tray, and moving down each upper tray, and supplying a fresh tray in the upper slide. The rate of drying in such a drier depends upon the

FIGURE 3.—Trays used for platform drying

amount of heat supplied and the loss of heat in the walls. Under no circumstance should the cost of drying be over one-third cent per pound to obtain a product with 5 per cent moisture.

Grinding.—The nature of the dried product requires the use of feed or grain grinders for reducing to desirable size. The spiny parts of the shrimp heads and tails are very brittle when dried and grind easily, as do the legs and body shell. The meaty portions in the heads and waste shrimp must be dried before grinding and give trouble unless the grinding is done step wise, first reducing the stock to about 9 mesh to the square inch size, then to about 25 mesh, and finally to the desired or fine size. The demands for the product will control the size of the ground stock, but, in order to reduce the spines to a harmless size, the grinding must be carried down to about 16 mesh, or lower, per square inch. A grinder of this type is the ordinary grain or feed grinder, with revolving disk plates to disintegrate the particles. These may be purchased in any size, but one of 5 bushels per hour capacity can be easily operated by one man. This meal can be stored without danger of spoilage as long as kept out of direct rain; humid weather does not affect it. It is a fine, dry product with no disagreeable odor. The yield approximates 540 pounds per ton of raw shrimp waste.

Chemical analysis.—Typical analyses of meals prepared by the above method are given in Table 3. The composition of the material would vary slightly with the season, upon the amount of shrimp meat thrown into the waste, and on the nature of the green stock, depending on whether it was heads or peeled waste.

The calcium phosphate and the high protein content should make this material a valuable poultry feed. Furthermore, the high iodine content of the meal is new to poultry feeds and should be expected to have the same beneficial effects on poultry and egg production as this substance has on other animals. The nature of the fat is not known, and its vitamin content is now being studied.

TABLE 3.—*Chemical composition of experimental meals prepared by the nonacid water-cook method*

Items	As analyzed	On dry basis	Items	As analyzed	On dry basis
	Per cent	*Per cent*		*Per cent*	*Per cent*
Moisture	5.5	--------	Calcium sulphate	0.18	0.20
Proteins	42.11	44.4	Potassium oxide	.52	.59
Calcium phosphate	6.67	7.02			
Ether extract	2.47	2.61	Iodine ....parts per billion	3,400	3,600
Sodium chloride (salt)	4.02	4.25			

ACID WATER-COOK METHOD

The initial procedure to be followed in the acid cook processing is similar to that of the nonacid cook. The difference in the procedure is at the cooking vats, where the operator must add slowly with rapid stirring 5 pounds of chamber acid (brown sulphuric acid of commerce) to every 100 pounds of the wet stock. This should be added just when the mass comes to a boil. In a few minutes the mass is neutral, the acid having reacted with the calcium carbonate found in the shell material of the shrimp heads. The cooked heads can then be dumped onto a platform or piled up and left to accumulate for a day or two to await attention when the canning plant operations do not require the laborers. One of the advantages of this method lies in the preservative action of the acid on the shrimp stock, permitting the stock to be laid aside for a day or so, should the weather be too inclement for platform drying or the help become scarce because of the rush in the canning plant. It also increases the yield over that of the nonacid cook. The yield of meal with approximately 8 per cent moisture is about 750 pounds from 1 ton of the raw shrimp waste. The worn out cooking vats can be utilized for cooking the heads, thus cutting the cost of extra cooking equipment to zero. The coils in the vats are usually galvanized and last for only a season or two, when too much iron becomes exposed to use for cooking shrimp meat. These vats can be put into use as waste shrimp cookers until they are exhausted.

Chemical analysis.—Typical analyses of meal prepared by the foregoing acid-cook method, using 3 per cent acid addition, are given below in Table 4.

TABLE 4.—*Chemical composition of experimental meals prepared by the acid water-cook method*

Items	As analyzed	Dry basis	Items	As analyzed	Dry basis
	Per cent	*Per cent*		*Per cent*	*Per cent*
Moisture	6.87	--------	Calcium sulphate	4.44	4.77
Proteins	46.42	49.84	Free ammonia	.17	.20
Calcium phosphate	6.74	7.24	Potassium oxide	.49	.54
Ether extract	1.77	1.81			
Sodium chloride (salt)	1.27	1.37	Iodine ---------- parts per billion	7,100	7,600

PREPARATION OF FERTILIZER MATERIAL

NONCOOK ACIDULATION METHOD

Uncooked shrimp waste may be converted into a fertilizer material that will permit storage by treatment with commercial sulphuric acid alone. The acid added has a slight dehydrating effect on the waste and prevents spoilage and fly infestation while the material is aging. During the aging period moisture is lost to the atmosphere, and a relatively dry product is obtained. Owing to the high moisture content of the raw material, which constitutes about 75 per cent of the total weight, the acid becomes quite dilute; therefore, it was found necessary to add as much as 330 pounds of acid to every ton of raw material treated.

The raw stock is spread on the mixing floor which may be a common brick floor or a heavy planked dock, and the desired amount of sulphuric acid is added. Mixing is accomplished by turning the mass over 3 or 4 times or by placing it in a lead-covered screw conveyor 6 inches in diameter and 10 feet in length, which will accomplish the mixing and also the conveying of the acidulated stock into the aging room or to the aging platform. The mixing can be done by laborers turning the waste on the platform with shovels. In any case where a wooden platform is used for acid treatment, the exposed wood should be protected by previous treatment with asphalt or similar material.

COOK AND ACIDULATION METHOD

Large canneries are able to eliminate the handling of large quantities of water, reduce the time of aging, and reduce the quantity of the acid to be used on the stock by previously cooking the waste in open wooden vats or iron kettles for a period of 10 minutes. This procedure reduces the water content of the stock to approximately 60 per cent and leaves a product that requires only 240 pounds of chamber acid to a ton of the cooked stock to prevent fly infestation and spoilage. The cooking can be accomplished by using the exhaust steam from the shrimp cookers with closed steam coils, or with live steam injected into the vat filled with water. The latter method is preferable, since it accomplishes agitation at the same time. Straight steaming gives a product that has a lower water content than the original heads, but, in order to accomplish preservation, the stock which has thus been steamed at 10 pounds pressure for 2 hours will require the same amount of acid as the green stock.

The waste is collected in heavy mesh baskets. These baskets should have handles extending out from the sides to facilitate carrying and to act as supports in the cooking vats. The total capacity of the baskets should be 5 bushels, but they should be only half full to permit suspended agitation. The half-filled baskets are carried into the cooking room, or covered space outside of the shrimp cooking room, and lowered into the boiling water in the wooden vats. The quantity of water in the vats must be sufficient to permit the heads to move freely in the baskets. Ten minutes of active boiling is sufficient for the preliminary preservation. The baskets are then removed to the mixing platform, where sulphuric acid is added at the rate of 240 pounds per ton, or 12 pounds per basket. Mixing is accomplished in the same manner as described for the noncook acidulation method.

Chemical analysis.—The chemical analysis of three samples of stock prepared by the cooking and acidulation methods described above, varying the amount of the acid added, are given in the first three columns of Table 5. When shrimp heads are treated with acid without cooking, the results depend on the quantity of the acid, which will vary with the degree of spoilage of the heads before the treatment started. When such waste is immediately attended to, a product can be obtained with an analysis approximating that of the last column in Table 5.

TABLE 5.—*Chemical composition of fertilizer materials prepared by the acidulation of cooked and uncooked material*

Items	Cook and acidulation method[1]			Noncook and acidulation method
	Batch 1	Batch 2	Batch 3	
	Per cent	*Per cent*	*Per cent*	*Per cent*
Yield	26.8	31.4	35.9	26.6
Moisture	11.8	11.3	11.6	11.9
Proteins (dry basis)	45.42	43.19	41.28	50.4
Calcium phosphate (dry basis)	7.71	7.64	6.58	5.45
Potassium oxide (dry basis)	.75	.52	.71	.46
Calcium suphate (dry basis)	7.66	7.93	12.83	5.31
Sodium chloride (salt, dry basis)	2.5	2.4	2.9	4.0
Ether extract (dry basis)	3.0	4.7	4.1	3.0
Iodine parts per billion	5,800	7,300	7,500	6,100

[1] Varying quantities of acid were used for acidulating the cooked waste. 2 per cent, by weight, of acid (based upon weight of stock) was used in acidulating batch 1, 3 per cent in batch 2, and 5 per cent in batch 3.

To insure the proper flow of materials through the plant the process will require the services of but 2 men working all the time, or 3 men leisurely. The cooking operation can be started just after the last of the shrimp has been placed on the tables. The three men usually employed for this who are at present unemployed can begin the processing, thereby extending their working day. The canning of shrimp extends itself well into the afternoon, while the peelers are generally relieved early. The canning operation usually extends 4 hours beyond the time when the last shrimp are peeled or headed. This interval could be used for the steaming of the waste and the acidulation, without requiring that steam be kept up for an extended period. Less care in handling is required with this material, and the product is in storage a much shorter time before it becomes softened enough for disintegrating and mixing with other fertilizer material. The yield varies slightly with the stock, but 1 ton of the raw shrimp heads produces approximately 760 pounds of fertilizer material.

GENERAL CONSIDERATIONS OF THE VARIOUS METHODS

Steaming versus cooking in liquids.—Experiments indicated the impracticability of using straight atmospheric steaming process. The resultant stock, after steaming under such conditions for periods as long as 2 hours, is not thoroughly processed, only that portion in thin layers or the waste on the surface appearing to be cooked. This waste easily putrefies and is susceptible to fly infestation. High pressure steaming requires sealed containers to effect the penetration of the steam into the stock. The use of liquid as a cooking medium is to be preferred, owing to the short time necessary for the penetration of the heat and the conversion of the albuminous matter into the coagulated mass in the stock. A 10-minute cooking in water is more effective than a 2-hour period of steaming.

Necessity of cooking.—Whether cooking is necessary or not depends upon the product that is sought. Cooking is necessary for all material intended for feedstuff. For material prepared for fertilizer use, shortening the time of cooking requires more acid to be added to the waste in order to prevent fly and maggot infestation. The amount of acid used varies with the rate of subsequent drying, less acid being required with rapid drying. A safe amount of acid with the cooked stock is 6 per cent and with the noncooked stock the lower limit is 10 per cent. However, this may be dropped to 8 per cent if the waste is ground to a pulpy mass before the acid treatment. In general it appears to be more economical to cook the shrimp waste before treatment.

Brine-cook versus water-cook methods.—The concentration of brine greatly influences the keeping qualities of the desiccated stock, since the salt content of the finished product is roughly proportionate to the brine concentration. Therefore, the brine has a distinct advantage over the water as a cooking medium. However, if it is desired that the product have a low salt content, then it will be necessary to reduce the brine concentration or eliminate the salt entirely. This last practice requires greater attention and care in handling of the shrimp after cooking than in the case of the brine cook. The use of brine does not materially affect the iodine, oil, or nitrogen content of the dried waste when the results are calculated to the salt-free basis.

Acid versus nonacid cook methods.—Sulphuric acid has the advantage of reducing the time of cooking necessary for preservation, but less acid is needed the longer the material is cooked. The concentration of the acid used should be kept low in order to minimize loss of valuable constituents by conversion of calcium carbonate to calcium sulphate. The acid cooked wet shrimp stock does not attract flies, and this method serves as an excellent process when the rush of work requires attention elsewhere.

PRODUCTION COSTS

Although no accurate data on costs of production can be compiled that will be applicable to all localities and at every plant, a fair estimate of the labor requirements may be given which can be used as a basis for calculating costs. The various procedures or methods of converting shrimp waste into salable and valuable fertilizer, poultry and cattle feedstuff require a few common operations such as collection of the waste, while in others, cooking and acid treatment constitute additional operations. The labor requirements for these operations are the same. An attempt is made in Tables 6 and 7 to present data that will be of service in calculating costs under local conditions. These data are given on the basis of treating 1 ton of shrimp waste, either heads or heads and shells, plus any undersized shrimp.

TABLE 6.—*Data for calculating labor costs in utilization of shrimp wastes*

[On basis of 1 ton of raw shrimp waste]

Items	Brine-cook method		Nonacid water-cook method		Acid water-cook method		Noncook acidulation method		Cook acidulation method	
	Workers	Time	Workers	Time	Workers	Time	Workers	Time	Workers	Time
	No.	*Min.*	*No.*	*Min.*	*No.*	*Min.*	*No.*	*Min.*	*No.*	*Min.*
Collection of waste	2	90	2	90	2	90	2	90	2	90
Cooking	2	75	2	75	2	75			2	75
Transportation to mixing platform									2	90
Mixing acid and waste					1	15	2	60	2	60
Transportation to storage	2	30	2	60	2	60	2	30	2	30

TABLE 7.—*Items for consideration in calculating costs for processing shrimp wastes*

[On basis of 1 ton of raw shrimp]

Items	Brine-cook method	Nonacid water-cook method	Acid water-cook method	Noncook acidulation method	Cook acidulation method
Chamber acid (pounds)	None	None	100	330	240.
Salt (pounds)	100	None	None	None	None.
Steam	Yes	Yes	Yes	No	Yes.
Equipment:					
(a) Collection baskets	Yes	Yes	Yes	Yes	Yes.
(b) Acid mixers	No	No	Yes	Yes	Yes.
(c) Cooking baskets and vats	Yes	Yes	Yes	No	Yes.
(d) Solar drying	Yes	Yes	Yes	Yes	Yes.
(e) Heat drying	Yes	Yes	Yes	No	No.
(f) Grinders	Yes	Yes	Yes	No	No.
Storage space	Yes	Yes	Yes	Yes	Yes.
Power for grinders	Yes	Yes	Yes	No	No.
Fuel for drying	Yes	Yes	Yes	No	No.
Yields (pounds)	660	540	750	550	760.

OTHER PRODUCTS FROM SHRIMP WASTE

Coagulable protein.—After about eight batches of shrimp meat are cooked for canning purposes, the brine becomes quite murky and milky in appearance. This liquor is run to waste and a fresh batch of brine is used for cooking. In one plant about 80 pounds of meat constitutes a cook. The time varies with the condition of the shrimp and runs from 6 to 20 minutes. Every eight batches constitutes a total of 640 pounds of cooked shrimp.

Acidification of this waste liquor with 0.0008 per cent by volume of hydrochloric acid, specific gravity 1.19, yields a precipitate of pure white coagulable protein. If this product is washed by decantation and filtered through a bag, a white product containing 50 per cent protein is obtained; and this constitutes 1.8 per cent of the weight of the liquor or a yield of 4.5 pounds from 640 pounds of the cooked shrimp. This coagulable protein may serve as a raw material for coagulable protein products, or could be used as base for the preparation of shrimp paste food specialties.

Iodine bearing shrimp glands.—Analyses of segregated portions of the shrimp revealed to the investigators that some parts of the shrimp contain more iodine than other. The anatomical location of the iodine-bearing glands or body substances has not been definitely established, although research work along this line is being conducted.

Shrimp oil.—The shrimp wastes when dried show an extraction of variable oil content ranging from 1 to 5 per cent depending upon the season and the water content of the waste. Cooking shrimp waste breaks up the oil cells or the oil-bearing organs, and the oil readily comes to the surface of the cookers and can be skimmed off. The cooked product retains about 2.25 per cent of oil, and this can be extracted with ether. The physical and chemical constants of the oil are not known, and an investigation of the oil is being carried out at present by the authors.

CONCLUSION

From the foregoing, it is evident that six processes are available for the profitable recovery of shrimp waste at isolated points with minimum overhead expense, thus insuring favorable operation where receipts of stock are subject to large and irregular fluctuations. Several products other than special shrimp meals are also possible of development.

EXPERIMENTS WITH MEATS AND MEAT SUBSTITUTES AS TROUT FOODS[1]

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and

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CONTENTS

INTRODUCTION

During the past several years the Bureau of Fisheries has been conducting a series of feeding experiments with fingerling and yearling trout. The object of these experiments has been to determine, if possible, the available foods which will give the most satisfactory results when fed to trout in the hatchery or in rearing ponds. These tests have all been conducted from the practical standpoint, and no attempt has been made to carry on fundamental investigations on the nutrition of trout. Accordingly, they have been conducted under as nearly typical hatchery conditions as possible, and it is believed that the results attained are a fair criterion of what may be expected from the various rations when fed on a large scale at hatcheries.

Since environmental conditions have a marked influence on the health and vigor of the fish, we realize that the results obtained with a given diet at different hatcheries may show considerable diversity; and in comparing our results with those from other stations this fact should be kept in mind. Furthermore, there is considerable evidence that different species of trout may give quite different results on the same diet, which again greatly complicates the problem for the trout culturist. The majority of our experiments have been conducted with the brook trout (*Salvelinus fontinalis*), although the

[1] Appendix VII to the Report of the United States Commissioner of Fisheries for 1930. B. F. Doc. 1079.

rainbow trout (*Salmo shasta*), the steelhead trout (*Salmo gairdneri*), and the lake trout (*Christovomer namaycush*), have been utilized to some extent. It is planned to conduct more extensive feeding experiments with rainbow and brown trout as soon as facilities are available.

In any consideration of the relative value of different trout foods it is important to bear in mind that rapidity of growth is not the only factor to be considered. Too often in the past this has been virtually the only criterion used in evaluating a trout food. Of course, the reason for this is perfectly obvious. We have no other means of comparing definitely the results obtained with different rations. We have no "yardstick" for making precise measurements of vigor and vitality in fish, yet anyone who has had experience in handling trout knows that they often show marked differences in this respect. Mortality records are very valuable as an aid in determining the relative efficiency of different rations and have been carefully kept in all of our experiments. The interpretation of these records has frequently been complicated, however, by the spread of specific infections among the fish in the experimental lots. The form, color, and behavior of the individual fish are among the most important criteria to be observed in forming an opinion as to the relative hardiness and vigor of different lots. There can be little doubt that trout which closely approximate the wild fish in these respects are more desirable for stocking purposes than the soft, fat, pot-bellied fish not infrequently seen at our hatcheries.

Available trout foods can be divided into three groups: The first group includes fresh fish and fresh meats, such as horse meat and the liver, lungs, and spleen of cattle, sheep, and hogs; the second embraces the various dried products of animal origin, such as meat meals, fish meals, and dried milks; while in the third group we have the vegetable products including wheat middlings, low grades of flour, shorts, soybean meal, and Mexican pinto beans. Although these products have been used for years by fish culturists, in many cases there is, as yet, no general agreement regarding their relative value as trout foods.

The experiments which form the basis of this paper were begun at the Manchester (Iowa) station in the spring of 1923. They were continued during the summer of 1924 at White Sulphur Springs (W. Va.) station. In the spring of 1925 it was decided to convert a small hatchery at Pittsford, Vt., into an experimental hatchery, and the feeding experiments were accordingly transferred to this station where they have been carried on each summer since that date. Unfortunately, for various reasons it has been found impracticable to continue the experiments during the winter.

METHODS

In all cases the feeding experiments were conducted under as nearly average hatchery conditions as possible. Fingerling trout were kept in standard hatchery troughs supplied with spring water of a uniform temperature. In order to reduce the possibility of oxygen deficiency to a minimum, the water was fully aerated before entering the troughs, and the flow was considerably in excess of that required by such small numbers of fish.

In our earlier work the experimental lots contained 500 fish which were reduced to 300 later in the season when the compartments became crowded. With these small lots of fish, each trough was divided by screens into two compartments of equal size with an interval between. Care was taken that the ration fed in the upper compartment contained no ingredient which was not likewise included in the ration fed to fish in the lower compartment. Otherwise, but one compartment was maintained to a trough.

Since our experience led us to believe that more reliable results could be obtained with larger lots it was decided to increase the number of fingerlings in each lot to 1,000 fish. Still later this number was increased to 1,500 fish, which we have adopted as the standard unit. Each lot is kept in a standard hatchery trough 12 feet long, 14 inches wide, and 8 inches deep, the average depth of water being about 6 inches. The fish are held in the troughs until the experiments are discontinued in the fall. Although the number of fish to the trough early in the season is much smaller than in ordinary hatchery practice, it is believed that more reliable results can be obtained in this way than to attempt to divide the lots later in the season, as would be necessary if the experiments were started with a larger number.

All our experiments with fingerlings at the Pittsford hatchery with the exception of those in 1928, have been started with very small fish which had been taking food but a short time. Consequently, in accordance with ordinary hatchery practice, the number of daily feedings early in the season was greater than later. At first the fish were fed four times a day, but later this was reduced to twice daily.

At each feeding the amount of food given was slightly in excess of that which was taken readily, so as to obviate any possibility of some of the fish being unable to get all they would eat. Needless to say, the troughs were carefully cleaned every day and no trouble was spared to keep them in perfectly sanitary condition.

Each season all experimental fish were hatched from the same lot of eggs, and every effort was made to keep them under as nearly identical conditions as possible. Consequently, all the lots of any one season are directly comparable; but owing to variations in the source of the eggs and other conditions this is manifestly not true of lots in different seasons, although, with few exceptions, our results with similar rations have been remarkably constant from year to year.

The experiments with yearling trout have been conducted in raceways supplied with brook water which showed considerable fluctuations in temperature. At no time, however, were the temperatures high enough to injure the fish. While it is obviously impossible to obtain as constant conditions in outdoor raceways as in hatchery troughs, every effort has been made to keep conditions in the experimental raceways as uniform as possible.

In these yearling experiments, just as with the fingerlings, our primary object has been to keep the fish under conditions similar to those found in the average hatchery. Although this has resulted in a less rigid control of environmental factors, it is believed that our results are more applicable to hatchery practice than would be the case had the fish been kept under less normal conditions.

Owing to the difficulties in obtaining yearling fish of sufficient uniformity for experimental work the number of fish in our lots has varied from 75 to 225 in different years. In no case, however, has the number been sufficient to result in overcrowding. Each season the same number of fish was used in each lot except in a few compartments which were somewhat larger than the standard size. In such instances larger numbers of fish were used so that the number of fish per unit area of water surface was the same in all compartments.

FRESH MEAT AND FISH PRODUCTS

BEEF LIVER

At this late date in the history of fish culture, despite marked differences of opinion on other foods, no one challenges the real value of raw beef liver as a trout food. Time-tried and time-proved, its use as a single element in the diet of hatchery-raised fish has doubtless met with greater success than has any other meat.

Because of its steadily advancing price, investigators have been at work for some time past to discover some substitute for beef liver. Heart, liver, lungs, and spleen of cattle, pigs, and sheep, as well as other meat products, have all received attention; but beef liver has withstood the competition, especially as a growth producer. Not that these other meats failed to give good results, but beef liver gave better, particularly with the smaller fingerlings.

Embody (1918) in search of cheaper trout foods, showed that certain combinations of dried animal meals when cooked with flour could be used successfully, providing 45 per cent of raw beef liver was fed also. On the other hand, very carefully conducted experiments by Morgulis (1918) led him to conclude that while beef heart was very satisfactory, beef liver was not a good food for trout. This conclusion was based on the ease with which beef liver gave up its components to the water, a great deal of nourishment being thus wasted. Fish culturists early recognized this fact when feeding finely ground liver, and the bureau's reports contain frequent suggestions as to how to feed liver less wastefully. One of the most common practices is to mix the ground liver with some flour or middlings which absorb the meat juices and act as a binder.

One of the first experiments undertaken at the Pittsford experimental station was the testing of the comparative values of beef liver, beef heart, and sheep liver for brook and rainbow trout fingerlings. In comparing results from these three meat diets with the brook trout (fig. 1) it was found that until the ninth week of feeding there was little difference in the growth of the respective lots; but as the weeks went by those on beef liver began to forge ahead, finishing at the close of the experiment definitely in the lead. The mortality among these fish was higher than in the beef-heart lot, although it was much lower than in the sheep-liver lot. There appeared to be little doubt that the increased growth after the ninth week was because it was by then unnecessary to grind the beef liver so fine, and there was less waste.

Rainbow fingerlings on these diets (fig. 2) reacted in practically the same manner. In comparing the growth curves of the two

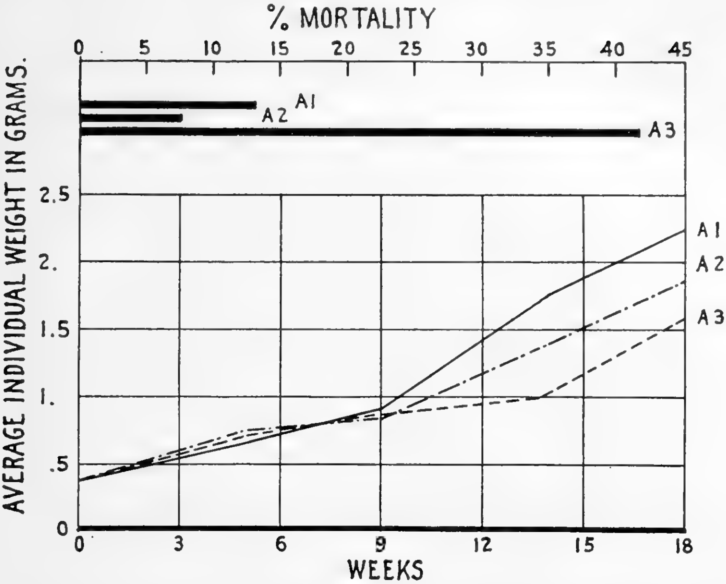

FIGURE 1.—Comparative growth and total mortality of brook trout fingerlings fed beef liver, beef heart, and sheep liver. (Compare with fig. 2.) *A1*=beef liver, 100. *A2*=beef heart, 100. *A3*=sheep liver, 100

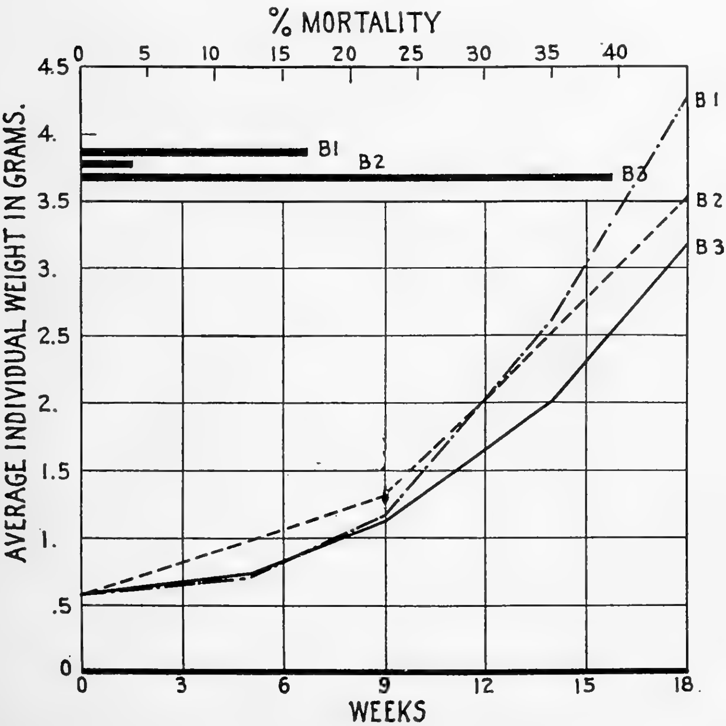

FIGURE 2.—Comparative growth and total mortality of rainbow trout fingerlings fed beef liver, beef heart, and sheep liver. *B1*=beef liver, 100. *B2*=beef heart, 100. *B3*=sheep liver, 100

species it is interesting to note that, although there is little difference in the size of the brook and rainbow fingerlings at the start of the experiments, the latter quickly widen the gap, making a much better growth and finishing far in the lead. This serves to illustrate the greater adaptability of the rainbow trout to hatchery conditions in general. In these experimental lots the rainbows were always less wild and would feed readily under conditions that would send the brook trout darting wildly to the darkest corners of the troughs.

In later experiments testing a great variety of meat and animal meal combinations, it was found that young fingerlings receiving beef liver as the meat constituent of the ration did much better than when other meats were used; and we still believe that, despite its higher price, beef liver will in the end prove a more economical food for young brook-trout fingerlings. With older fish, of course, a variety of cheaper meats is available.

BEEF HEART

Few real objections have ever been raised as to the value of beef heart as a trout food. The most common objection that trout culturists have made to the feeding of this meat is the waste and labor involved in removing the fatty and connective tissues before the heart can be prepared satisfactorily for feeding to fingerlings. Beef heart has, however, one great thing in its favor. Whenever this food has been used in our experimental diets there has been noticed a very beneficial effect on the mortality. (Figs. 1 and 2.) Considered from this standpoint alone, beef heart is undoubtedly at the head of the list of available meats. The present demand, however, for rapid growth can best be satisfied by the use of some beef liver in addition. Both brook and rainbow fingerlings do well on a diet of beef heart.

The consistent correlation between beef liver and a superior growth and beef heart and a low mortality suggested the advisability of a direct combination of these into one ration. Accordingly in 1927, one lot of brook fingerlings and one of rainbow fingerlings were started on a ration consisting of 50 per cent each of beef liver and beef heart. The results were even better than anticipated. The brook-trout fingerlings made a growth very close indeed to that made by the lot on beef liver with an accompanying mortality even lower than that of the beef-heart lot. The rainbow fingerlings responded in the same manner to the ration and made a better growth than those on straight beef liver. There was practically no difference in the mortality of this and the beef-heart lot, both being very low.

The same ration repeated in the 1928 series again gave excellent results. The fish used in 1928 were, however, almost 2 inches long when the experiments were started and had thus passed over the period of high mortality so often found in advanced fry and very young fingerlings. Consequently, the mortality figures in this season's work are lower than they would have been had the experiments been started earlier. The results obtained with mixture of beef liver and beef heart are, nevertheless, directly comparable with those obtained from the other rations and are a real indication of the value of the food.

The early mortality mentioned above can often be checked by proper feeding. Our experience has shown that the following practice is very satisfactory in producing rapid growth with low mortality: For the first 3 or 4 weeks the young fingerlings are fed beef heart exclusively. This meat can be ground into very fine particles with little waste. After the fourth week the food need not be ground so fine and 50 per cent of beef liver can be added to the ration. This provides the fingerlings with larger particles of a very nutritious food which can be used less wastefully than when the fish are smaller. The continued use of beef heart in the ration tends to lower the mortality.

BEEF MELTS

Beef melts or spleen is one of the cheapest meats available to fish culturists. In our experiments fingerling and yearling brook trout were fed this meat straight and in combinations with dry products. (Figs. 10 and 11.) In practically all cases very poor growth resulted, although the accompanying mortality was rather low. Any instance in which a ration containing beef melts gave good results was directly traceable to some other constituent in the ration. We must conclude, therefore, that despite any advantage in price the poor growth made by trout on this diet is alone sufficient reason for not including it among the suitable hatchery meats.

PIG LIVER

Pig liver is another staple meat which has been used extensively. As a food for both brook and rainbow fingerlings it has proved inferior to beef liver, particularly in regard to growth. (Fig. 10.) The exceptional stickiness of ground pig liver is an objectionable feature when it is fed to fingerlings in hatchery troughs, since it materially increases the labor involved in keeping troughs and screens in a clean and sanitary condition.

Pig liver, when fed straight or in combination with other foods, has made an excellent showing with yearling trout. (Fig. 11.) It is especially adapted for use with dry products, since it makes an ideal binding medium and will permit the use of quite fine meals which are difficult to feed without a great deal of waste unless held together by some sticky material.

The addition of 50 per cent beef heart to the pig-liver ration of brook-trout fingerlings resulted in added growth and a lowering of the mortality. No advantage from this combination was noted with rainbow fingerlings. Yearling brook trout fed on this meat mixture gave no evidence that the ration was superior to pig liver alone.

SHEEP LIVER

Considering its popularity at many hatcheries our results with sheep liver have been disappointing. With brook fingerlings (fig. 1) the mortality was very high and the growth unsatisfactory in comparison with fish fed on beef liver or beef heart. Consequently, we have made no attempt to feed sheep liver to young brook trout in our later experiments.

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With rainbow fingerlings (fig. 2) sheep liver made a somewhat better showing, although it was still decidedly inferior to beef liver. Fish on a straight diet of sheep liver showed a high mortality, but when the liver was combined with other products fairly good results were obtained. Although brook-trout fingerlings on the same combinations showed a better growth and lower mortality than on straight sheep liver the improvement was not as marked as with the rainbows.

Both brook and rainbow yearlings did well on a diet of straight sheep liver, no unusual mortality appearing. Although the latter species again did somewhat better the results, in general, were not sufficiently encouraging to warrant the use of sheep liver in preference to other and cheaper meats.

FRESH FISH

Hatcheries located near an available supply often make use of fresh fish in considerable quantities. The fish used consist usually of "rough," inferior species, unpopular with the trade, and selling at prices attractive to the hatchery operator. As there has always been more or less prejudice and difference of opinion as to the suitability of fish as a trout food, the 1928 feeding program at the Pittsford hatchery included some lots of fingerling and yearling brook trout on fresh fish diets. A few lots of rainbow fingerlings were also used.

The fish was donated by the General Seafoods Corporation, Gloucester, Mass., a carton of freshly frozen packages being shipped each week. This consisted of "bone loaf," herring, and mackerel. "Bone loaf" is a by-product of the fillet industry, being made from the bones and whatever flesh adheres to them after the filleting process. It was received in a frozen condition, finely ground, and compressed into bricklike cakes. The herring used consisted of the whole animal, and the mackerel of heads and fin scrap, both kinds of fish being ground fine and frozen.

The brook-trout fingerlings on the herring ration made the best growth (fig. 9), those on "bone loaf" next, while the fish on mackerel made a very poor showing. The addition of 50 per cent beef liver to the "bone-loaf" ration gave greatly improved results and indicated a possible way to make use of this product if it were ever put on the market as a food for trout. Results with the fish in general were, however, greatly inferior to those obtained from the standard meats.

A real objection to these fish products was the fact that they thawed quickly and were then very difficult to keep fresh—mackerel being particularly unpleasant. This was very greasy and spoiled easily.

The mortality following the use of the straight fish rations was consistently very high in the brook-trout lots. The rainbow fingerlings, on the other hand, did fairly well, making a good growth, accompanied by a moderate mortality. This fact again indicated the greater tolerance and adaptability of the rainbow for hatchery conditions in general.

Brook-trout yearlings were fed no "bone loaf" but received the mackerel and the herring with results inferior to those obtained from fresh meat, although with these older fish the difference was less marked.

From these results we can not recommend fresh fish as an important item in the menu of trout. In the case of hatcheries located near an abundant supply cheap fish might prove economical when fed in conjunction with meat, but its sole use emphatically is not recommended.

COOKED MEATS

Most fish culturists agree that cooked meats do not prove as satisfactory for trout as raw meats, and our own experiments have further verified this belief. In all cases poorer growth and higher mortality followed the use of cooked meat which was not eaten by the fish as readily as the raw product. An experimental lot of brook-trout fingerlings kept for 103 days on cooked liver suffered a loss four times greater than a lot on raw liver. There thus appears to be no advantage in cooking meats before feeding. Although fish on cooked meats might appear healthy for some time following its use it is safe to say that continued feeding of nothing but cooked meat will bring very unsatisfactory results.

DRIED ANIMAL PRODUCTS

Prior to 1929 practically all the dry products used in our experiments were mixed with warm water so as to form a thick mush before being incorporated with the ground meat; and, unless specifically stated otherwise, it is to be understood that this was the method employed. In moistening the meals the amount of water required to make a mixture of the proper consistency was carefully determined in the case of each meal, and this amount was rigidly adhered to in all our work. The actual percentage of each dry product used in our experimental rations can be determined by making allowances for a water content as follows: Clam meal and buttermilk, 50 per cent; shrimp meal, 60 per cent; haddock and menhaden meals, 65 per cent; and cod-liver meal, 67 per cent.

This method was adopted since it was thought that by moistening the dry products before they were mixed with the meats a mixture was obtained which was eaten more readily than when the dry meals were added directly to the ration. Carefully controlled experiments during 1929 have convinced us, however, that with most dry products this is not the case, although there are some, such as coarse shrimp meal, which can not be fed without preliminary moistening.

"CLAM HEADS"

"Clam heads" is the trade name given to a by-product of the clam canneries. It consists almost entirely of the siphons and small fragments of the gills and mantle, which are discarded by canners. This product is dried and either placed on market as it comes from the driers or ground into a coarse or fine meal. "Clam heads" has given us by far the best results of any dry product with which we have experimented; but, unfortunately, there is only a limited quantity available, and for that reason it can never become a staple trout food.

Experiments with this product for three years in succession have consistently yielded excellent results, both as regards growth and mortality. It is one of the few dry products which can be fed successfully to small fingerlings; but, like all such products, it should always be fed in combination with fresh meat.

The rapid growth of fingerlings on a mixture of clam meal and beef liver is shown in Figure 3. This mixture has proved a better

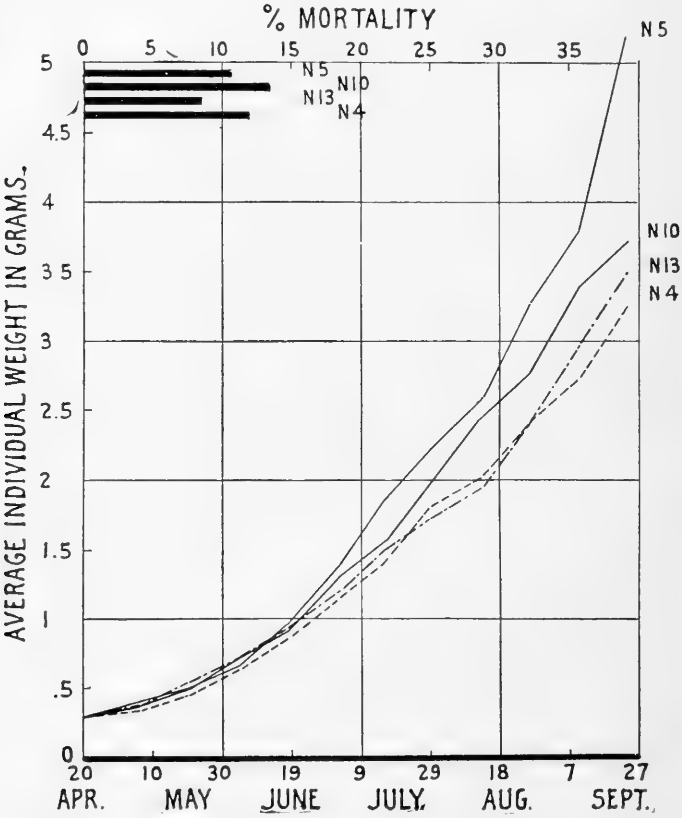

FIGURE 3.—Comparative growth and total mortality of brook trout fingerlings fed clam meal, buttermilk, and dry skim milk. *N5*=beef liver, 75; dry clam meal, 25. *N10*=beef liver, 75; dry buttermilk, 25. *N13*=beef liver, 75; dry skim milk, 25. *N4*=beef liver, 50; clam meal (moist), 50

food for brook-trout fingerlings than any straight meat diet, and we consider it the best trout ration which has been developed up to this time. Since beef melts do not prove satisfactory when fed straight it is interesting to note that a much better growth is made when 50 per cent clam meal is added to the ration. (Fig. 4.)

Experiments with yearling brook trout show that they also make a better growth on various combinations of "clam heads" and meat than on the meat diets alone. (Fig. 11.) Naturally, mixtures of "clam heads" and the better meats give somewhat better results than when the product is used with the poorer meats, but the superiority of the better combinations is not so great as might be expected. In fact, our experiments with yearlings and older fish indicate that clam heads can be fed in combination with almost any fresh meat with satisfactory results.

During the past two years a considerable percentage of "clam heads" has been included in the ration of the brood stock at the Pittsford experimental hatchery, and the results have been highly

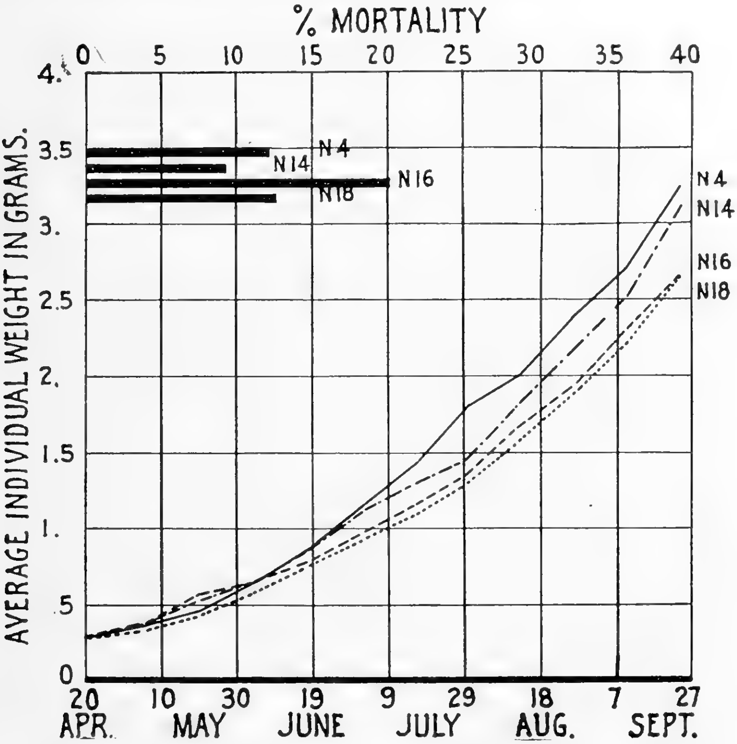

FIGURE 4.—Comparative growth and total mortality of brook trout fingerlings fed clam meal combined with various meat products. *N4*=beef liver, 50; clam meal, 50. *N14*=beef liver, 25; beef heart, 25; clam meal, 25. *N16*=beef melts, 50; clam meal, 50. *N18*=beef melts, 25; beef heart, 25; clam meal, 25

satisfactory. The fish are vigorous and healthy, the form of the body closely approximating that of wild fish, and the coloration is better than is usually the case in hatchery fish. The quality of the eggs has also been uniformly good. The effect of the food on the eggs, however, has not been checked by carefully conducted experiments, but we are hoping to carry on investigations in this field in the near future.

Good results have also been obtained with a meal manufactured from the dried meats of fresh-water mussels. This meal was found to be somewhat inferior to the meal derived from clam heads; and since there is no probability of its being available in commercial quantities its use was discontinued in our later experiments.

FISH MEALS

In our experiments with fish meals we have not attempted to feed them straight to any extent, but in practically all cases have used them in combination with fresh meats. We have tried menhaden, pilchard, haddock, and cod-liver meals with fingerling and yearling brook trout and have met with fair success. The menhaden and the pilchard meals are made from the entire fish. The haddock meal—also known as "white fish meal"—like "bone loaf," consists of the waste flesh and bones incidental to the preparation of fillets, only in this case it is vacuum dried and ground into a fine white meal.

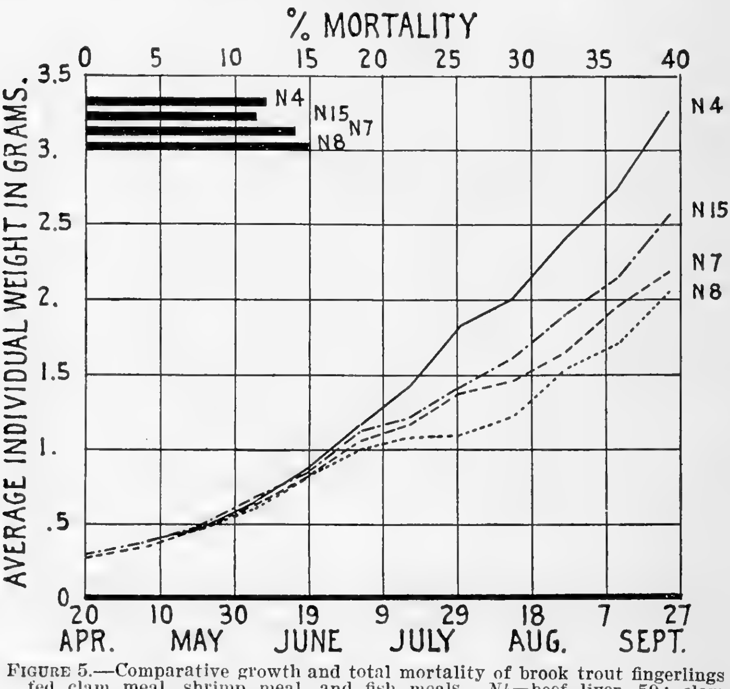

FIGURE 5.—Comparative growth and total mortality of brook trout fingerlings fed clam meal, shrimp meal, and fish meals. *N4*=beef liver, 50; clam meal, 50. *N15*=beef liver, 50; pilchard meal, 50. *N7*=beef liver, 50; haddock meal, 50. *N8*=beef liver, 50; shrimp meal, 50

The cod-liver meal used was of a much better grade than that usually sold for stock feeding.

Figure 5 shows the respective growth made by the fingerlings on clam, pilchard, haddock, and shrimp meals when fed with 50 per cent beef liver. These data show clam meal to be definitely superior to either fish or shrimp meals. Pilchard meal is next in value, but there is very little difference in the growth of the fish on either the haddock or the shrimp, although the former made a slightly better showing.

It is interesting here to note that the fingerlings on the pilchard meal show a more uniform growth than those on the haddock or the shrimp. A possible explanation is the physical consistency of the respective products. The shrimp and haddock meals are light and finely ground, being difficult to use without considerable waste. There was always a fine precipitate of these meals on the bottom of the troughs following feeding, and the fingerlings were never seen eating it. Pilchard meal, on the other hand, being heavier and coarser, was much easier for the fish to pick up and eat. It was, furthermore, less distinguishable from the particles of liver, which in the case of the haddock and shrimp combinations were easily selected and eaten. This resulted in the more active, stronger fish securing most of the meat before the smaller ones could do so. An irregular lot of fingerlings in respect to size was the natural result. Systematic weighing of samples from these lots revealed the irregularities in the size of the fish, it being particularly evident in the growth curves. As

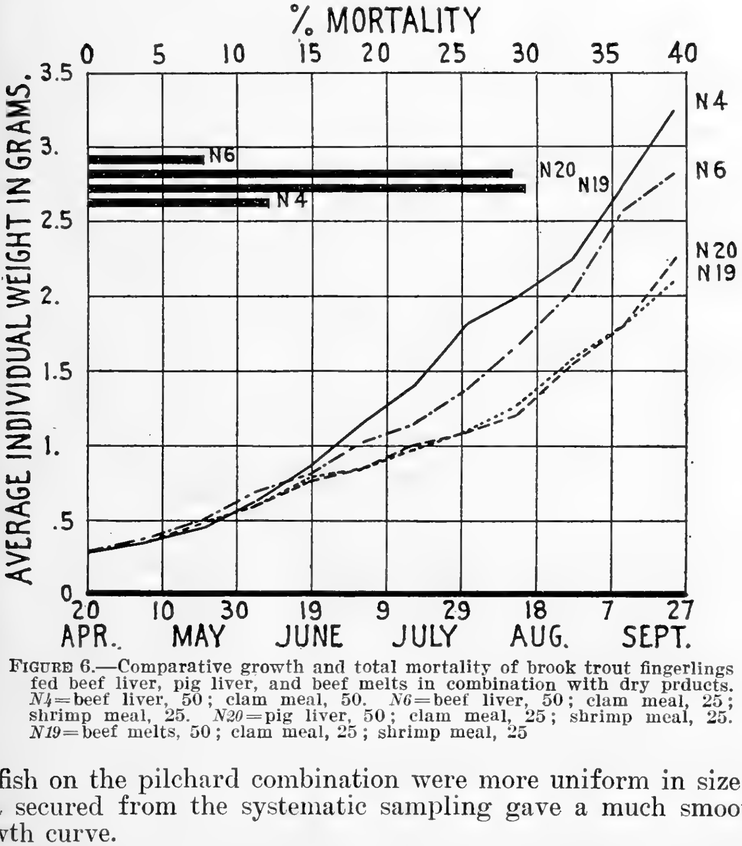

FIGURE 6.—Comparative growth and total mortality of brook trout fingerlings fed beef liver, pig liver, and beef melts in combination with dry prducts. *N4*=beef liver, 50; clam meal, 50. *N6*=beef liver, 50; clam meal, 25; shrimp meal, 25. *N20*=pig liver, 50; clam meal, 25; shrimp meal, 25. *N19*=beef melts, 50; clam meal, 25; shrimp meal, 25

the fish on the pilchard combination were more uniform in size the data secured from the systematic sampling gave a much smoother growth curve.

Our results also revealed that there was nothing gained in feeding a combination of haddock and shrimp meals. A combination of 50 per cent beef liver and 25 per cent each of shrimp and haddock meals merely resulted in a rate of growth closer to that obtained on a diet of haddock and beef liver, which has already been observed to be slightly better than a shrimp combination.

The haddock meal proved to be somewhat superior to the menhaden meal (fig. 9), and the difference would probably have been more marked had the ordinary commercial grade of menhaden meal been used in our experiments. Although the menhaden meal was flame dried, the deleterious oils had been extracted by a special process developed by the bureau so that the resulting product was comparatively light in color and above the average grade. Both haddock and menhaden meals gave quite satisfactory results with yearling trout.

The cod-liver meal was also difficult to use without waste, as it was very fine and light. Even when mixed with meat before feeding it was easily separated on contact with the water; and, as with shrimp and haddock meals, the trout left it alone after its precipitation on the bottom of the trough.

SHRIMP MEAL

Shrimp meal is a waste product of the shrimp canneries and large quantities are produced annually, although at the present time only a small percentage of the available supply is being utilized. As ordinarily sold it consists chiefly of the dried fragments of the head, thorax, and legs of shrimp. The entire bodies of shrimp which are too small for canning are also included, and not infrequently these may form a considerable percentage of the total. It will thus be seen that the product varies considerably in nutritive value but always contains a high percentage of protein and chitin. Of course, the chitin is indigestible, but may serve a valuable purpose as "roughage." In this respect shrimp meal is quite similar to the natural food of trout. Like most marine products, shrimp meal contains a relatively high percentage of essential minerals and from this standpoint alone should make a valuable adjunct to the fresh meats which are deficient in this respect.

In addition to the coarse meal referred to above, which is frequently called shrimp bran, there is also available a finely ground product which can be fed to small fingerlings. The ordinary shrimp bran is too coarse to feed to fish under 4 or 5 inches long.

When fed to yearlings in combination with fresh meats shrimp meal has given results comparable to those obtained with fish meals. (Fig. 11.) While the growth is not as rapid as with "clam heads" it is quite satisfactory, nevertheless, and owing to the relatively low price of shrimp meal it may prove to be more economical than the fish meals. When fed in combination with "clam heads" the growth was nearly equal to that obtained when the latter was the only dry constituent in the ration. The mortality in lots fed a ration containing shrimp meal was low, and the fish were always vigorous with excellent coloration.

Our experiments indicate that nothing is to be gained by the addition of shrimp meal to mixtures of meat and fish meals, but a beneficial effect was evident when it was added to a mixture of sheep liver and soybean meal at a 10 per cent level.

Shrimp meal is a less satisfactory food for fingerlings than for larger fish, a mixture of equal parts beef liver and shrimp meal producing a relatively slow growth. (Fig. 5.) In our experiments for 1928 (fig. 9) only menhaden meal was inferior to shrimp meal in this respect, and in the following year the mixture of beef liver and shrimp meal made the poorest showing of any of the beef-liver combinations. In view of these results the inclusion of any considerable quantities of shrimp meal in the diet of young fingerlings is not recommended.

MILK PRODUCTS

We have used only two examples of dried milks in our experiments—a dry skim milk and a dry buttermilk. The former is a fine powder, which is readily soluble in water, while the latter is insoluble and can be obtained in the form of meals of varying degrees of coarseness. Some of the meals are ground very fine, while the coarser grades may contain particles up to one-eighth of an inch in diameter.

McCay and his coworkers (McKay, Bing, and Dilley, 1927; McKay, Dilley, and Crowell, 1929) have obtained excellent results with dry skim milk and conclude that a mixture of skim milk and beef liver is superior to beef liver alone. They were even able to keep brook-trout fingerlings for 15 weeks on a diet of skim milk and cod-liver oil with a 500 per cent increase in weight. At the end of this time, however, the fish ceased to grow and began to die rapidly.

In our own experiments dry buttermilk has given better results than skim milk, although the differential in favor of the former was not great. Probably the superiority of buttermilk is due largely to its insolubility. It is very difficult to feed dry skim milk without a considerable percentage going into solution in the water before the fish can get it. There is no evidence that the comparatively high acidity of buttermilk has any deleterious effect on the fish.

In order to determine the comparative value of clam meal, dry buttermilk, and dry skim milk, three lots of brook fingerling during the summer of 1929 were fed a ration composed of 75 per cent beef liver, supplemented with either 25 per cent dry clam meal or the same percentage of dry skim milk or dry buttermilk. (Fig. 3.) At the end of the season the average individual weight of fish fed on beef liver and clam meal was 5.17 grams; of those fed on beef liver and buttermilk, 3.72 grams; and of those fed beef liver and skim milk, 3.50 grams. The differences in the mortality of the three lots were not significant.

Another lot of fish was kept on a ration made up of 40 per cent beef liver and 60 per cent "consolidated buttermilk." Although the fish in this lot made practically the same growth as those receiving beef liver and dry skim milk (Fig. 10) the results are believed to be of little value. The "consolidated buttermilk" has much the same consistency as clabbered milk, and consequently large amounts are lost in feeding. In fact, so much of the buttermilk was lost that it was necessary to feed much larger amounts of the mixture than in the case of beef liver and dried milk. Consequently, the fish were actually receiving a much larger quantity of liver than is indicated by the composition of the ration, and it is probable that their rapid growth was largely due to this fact.

Owing to the excessive waste in feeding "consolidated buttermilk" and similar products they are a much less economical food for trout than dry buttermilk. Aside from their food value, however, these products appear to have a tonic effect; and where they can be obtained at a low cost their inclusion in the diet may be advisable from this standpoint. Trout appear to be very fond of all milk products, either moist or dry, and their presence in a ration no doubt often makes it more palatable.

During the summer of 1925 a lot of lake-trout fingerlings was kept on a diet of sheep liver and clabbered sour milk for a period of four months. In this case the milk was not mixed directly with the liver, but the fish were given alternate feedings of liver and clabbered milk. The growth was practically identical with that of the controls fed straight sheep liver, but near the close of the experiment the mortality of the fish on liver and milk showed a considerable increase over that of the control.

For some unknown reason dry buttermilk has not made as favorable a showing with yearlings as with fingerlings. (Fig. 11.) In combination with pig liver dry buttermilk produced only a moderate growth, although when shrimp meal was added to the ration the growth was considerably better. With beef melts the buttermilk made an even poorer showing than with pig liver. We are planning more extensive experiments with dry buttermilk in the rations of yearlings in the hope that some explanation will be found of the apparent discrepancy in the results with fingerlings and yearlings. No attempt has been made to include dry skim milk or " consolidated buttermilk " in the diets of yearlings.

CEREALS AND SIMILAR PRODUCTS

WHEAT MIDDLINGS

Probably no cereal products have been used more consistently than wheat middlings or low-grade flours. Although our results from feeding middlings have been somewhat conflicting, we are of the opinion that this product has comparatively little nutritive value in trout rations. It is exceedingly doubtful if trout can make use of raw starches, and it is probable that any apparent advantage derived from the presence of middlings or flour in the ration is due to the fact that they absorb the meat juices which otherwise would be largely lost. Thoroughly cooked middlings are no doubt superior to the raw product but, nevertheless, have made a poorer showing in our experiments than the fish meals or dried milks. (Fig. 11.)

SOYBEAN MEAL

As the protein constituent of this meal more closely resembles animal protein than is the case with cereals it was one of the first vegetable products selected in our investigation of possible meat substitutes. Soybean meal was incorporated into meat rations of brook and rainbow fingerlings (figs. 7 and 8) at a 25 per cent level. In both cases lower growth resulted, being more marked in the case of the rainbows. The growth made by the brook trout when soybean meal was included in their ration was not greatly inferior to that produced by straight meat. In general, however, we found that the addition of this meal to the meat rations of brook trout, fingerlings, and yearlings alike, resulted in definitely retarding the rate of growth. This was directly proportional to the amount of soybean meal used. For some reason rainbow trout on a ration containing 25 per cent soybean meal made a much poorer showing than brook trout.

MEXICAN PINTO BEANS

Reports of the successful use of cooked beans at certain rainbow hatcheries in the West led to our giving this food a trial. The results were similar to those obtained from the feeding of soybean meal. When incorporated at 25 per cent in the meat ration lower growth again resulted. With brook fingerlings (fig. 7) there was little difference in the growth when either Mexican beans or soybean meal was used, although results with soybean meal were slightly better. Rainbow fingerlings, however, did much better on Mexican

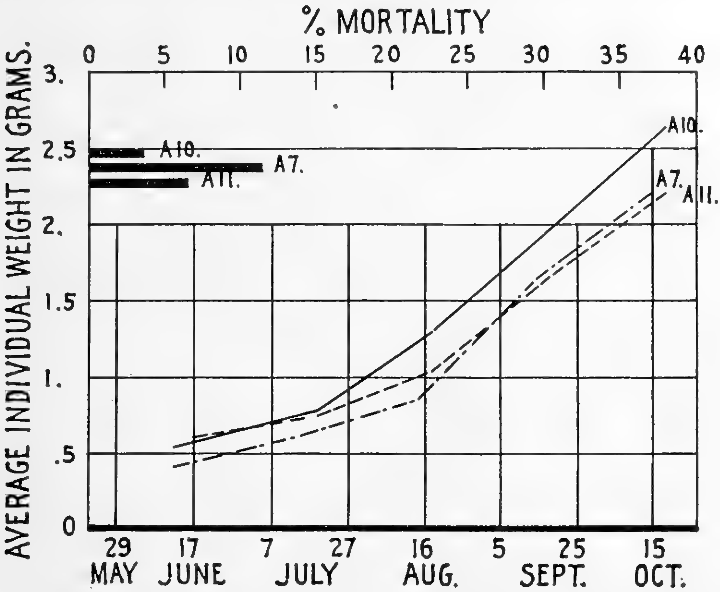

FIGURE 7.—Comparative growth and total mortality of brook trout fingerlings fed beef liver, soybean meal, and Mexican pinto beans. *A10*=beef liver, 50; beef heart, 50 (control). *A7*=beef liver, 75; soybean meal, 25. *A11*=beef liver, 75; Mexican pinto beans, 25

bean than on soybean combinations. (Fig. 8.) Experiments with yearling brook and rainbow gave comparable data.

Despite the fair success with Mexican beans, it does not seem advisable to use them in preference to a suitable animal product, as there is considerable trouble involved in cooking and preparing them for trout. Bing (1927) arrived at similar conclusions, as he found that trout receiving cooked beans in combination with raw liver made a growth inferior to those on straight liver.

MISCELLANEOUS PRODUCTS

FOX FOOD

There is considerable demand from various individuals and organizations rearing small numbers of fish in nursery ponds for some cheap canned product suitable for trout. We have used but one food of this type.

At the request of Swift & Co., we tested one of their canned-meat products which is on the market under the trade name of "Silver Fur Food." This is a balanced ration put up expressly for the feeding of foxes on fur farms.

Brook-trout yearlings on this diet made a satisfactory growth during the course of the experiment (fig. 11) with no marked mortality appearing, as is often the case when using a straight diet of dry or cooked foods. The period of feeding, however, was not sufficiently long to justify any final conclusions as to its real worth.

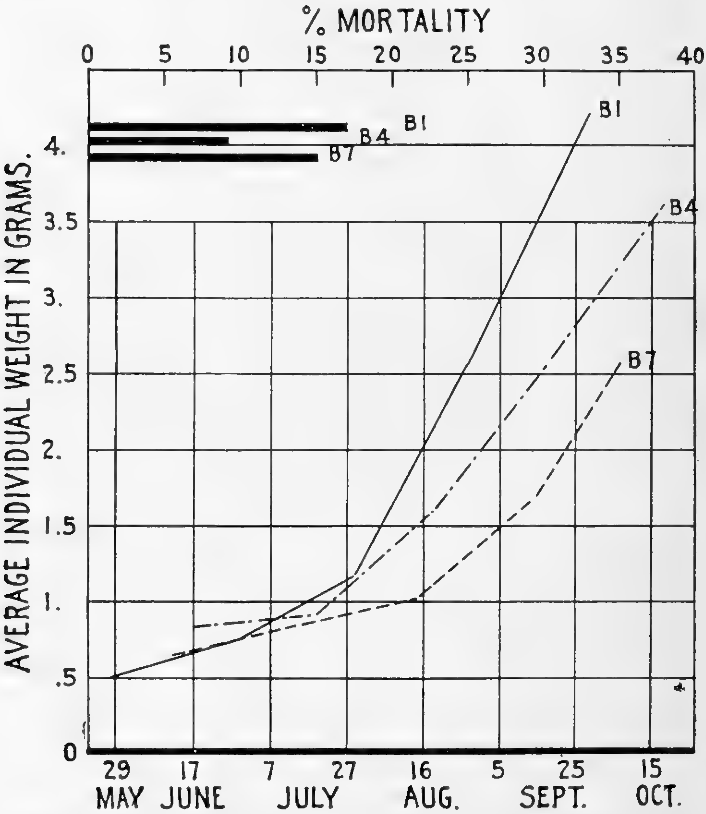

FIGURE 8.—Comparative growth and mortality of rainbow fingerlings fed beef liver, soybean meal, and Mexican pinto beans. *B1*=beef liver, 100 (control). *B4*=beef liver, 75; Mexican pinto beans, 25. *B7*=beef liver, 75; soybean meal, 25

Should this or a similar product prove a satisfactory substitute for part of the fresh-meat rations of trout it would doubtless be found welcome in many situations. The advantage of having on hand a constant supply of food, the feeding of which involved only the minor difficulties of opening tins, would alone make it popular.

COD-LIVER OIL AND YEAST

Many of the earlier experiments were designed primarily to determine if the foods ordinarily supplied to trout at hatcheries are sufficiently rich in vitamins. Fingerling trout kept on beef or sheep liver showed no evidence of vitamin deficiency. With beef heart, however, the results were confusing. Fingerling rainbows made a much better growth with less mortality when small amounts of cod-liver oil and dry yeast were added to the meat. With brook fingerlings, on the other hand, no appreciable difference could be detected between the lots fed straight beef heart and those receiving small amounts of cod-liver oil and yeast in addition. Apparently rainbow trout are more susceptible to vitamin deficiency than are brook trout. In this connection it is interesting to note that

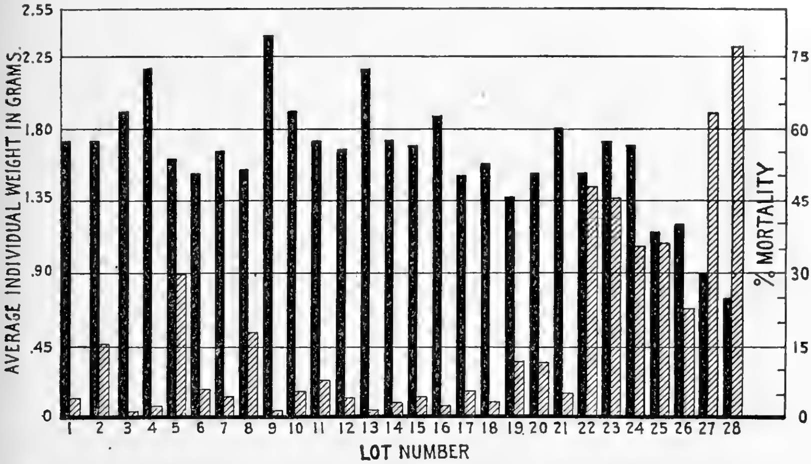

FIGURE 9.—Comparative growth and mortality of brook trout fingerlings on experimental rations, July 12 to October 15, 1928. Since the fish in all lots were approximately the same size on July 12, comparisons are based on average individual weights at the close of the experiment. Shaded columns indicate average individual weights in grams at the close of the experiment. Cross-hatched columns indicate total mortality during the course of the experiment. The rations of the individual lots were as follows: *1*=pig liver, 100. *2*=pig liver, 85; dry skim milk, 15. *3*=pig liver, 50; beef heart, 50. *4*=beef liver, 50; beef heart, 50. *5*=pig liver, 33⅓; shrimp meal, 33⅓; cod-liver meal, 33⅓. *6*=beef heart, 33⅓; shrimp meal, 33⅓; cod-liver meal, 33⅓. *7*=beef liver, 33⅓; shrimp meal, 33⅓; menhaden meal, 33⅓. *8*=beef liver, 33⅓; shrimp meal, 33⅓; haddock meal, 33⅓. *9*=beef liver, 50; clam meal, 50. *10*=beef liver, 33⅓; clam meal, 33⅓; shrimp meal, 33⅓. *11*=beef liver, 50; mussel meal, 50. *12*=pig liver, 50; mussel meal, 50. *13*=beef heart, 85; dry skim milk, 15. *14*=beef heart, 50; cod-liver meal, 50. *15*=beef liver, 50; shrimp meal, 50. *16*=beef liver, 50; haddock meal, 50. *17*=pig liver, 50; haddock meal, 50. *18*=beef liver, 50; menhaden meal, 50. *19*=pig liver, 50; menhaden meal, 50. *20*=pig liver, 50; shrimp meal, 50. *21*=beef liver, 50; "bone loaf," 50. *22*="bone loaf," 100. *23*="bone loaf," 90; cod-liver meal, 10. *24*=herring, 100. *25*=mackerel, 100. *26*=shrimp, menhaden, mussel, and cod-liver meals mixed in equal parts and fed 5 days a week; beef liver 2 days a week. *27*=meals (as in 26), 80; dry skim milk, 20. *28*=meals (as in 26), 100

Metzelaar (1929) has found that algæ form a considerable percentage of the food of the wild rainbows, but this does not appear to be true of the brook trout.

These experiments on the addition of vitamin-rich products to trout foods were fully described by Davis and James (1924), and the reader is referred to this publication for further details.

CONCLUSIONS

As a result of our experiments we feel we are justified in reaching more or less definite conclusions regarding the comparative value of certain products as trout foods. We realize fully, however, that any such conclusions must be left open to revision or modification, since future experience may show that in some respects our results may have been misleading.

As previously pointed out we have no yardstick by means of which we can compare with preciseness the results obtained in

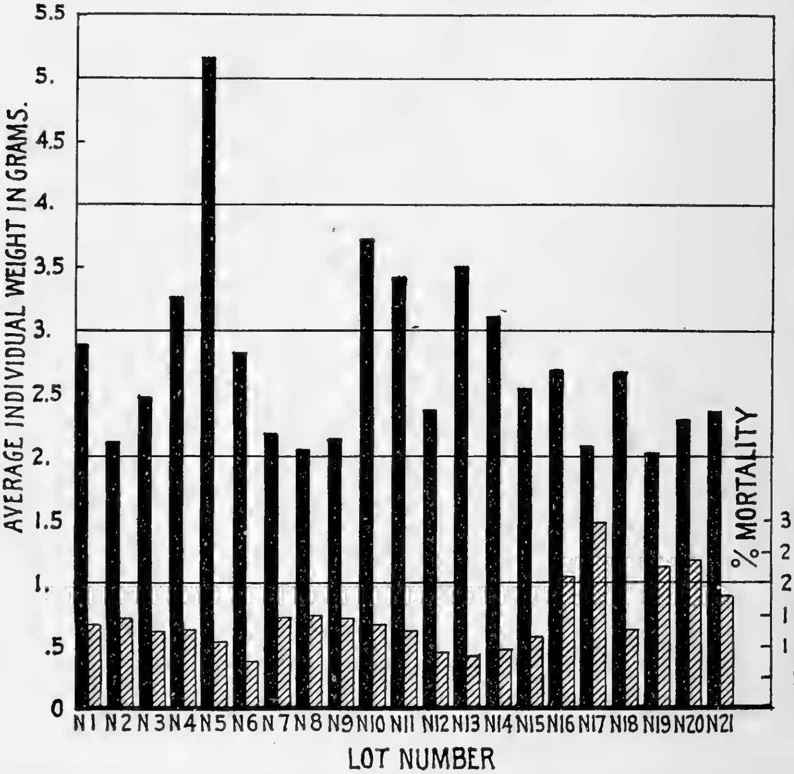

FIGURE 10.—Comparative growth and mortality of brook trout fingerlings on experimental rations, April 20 to September 24, 1929. Since the fish in the various lots were approximately the same size on April 20, comparisons are based on average individual weights at the close of the experiment. Shaded columns indicate average individual weight in grams at close of experiment. Cross-hatched columns indicate total mortality during the course of the experiment. The rations of the individual lots were as follows: *N1*=beef liver, 50; beef heart, 50. *N2*=beef melts, 100. *N3*=beef melts, 50; beef heart, 50. *N4*=beef liver, 50; clam meal, 50. *N5*=beef liver, 75; dry clam meal, 25. *N6*=beef liver, 50; clam meal, 25; shrimp meal, 25. *N7*=beef liver, 50; haddock meal, 50. *N8*=beef liver, 50; shrimp meal, 50. *N9*=beef liver, 50; haddock meal, 25; shrimp meal, 25. *N10*=beef liver, 75; dry buttermilk, 25. *N11*=beef liver, 40; "consolidated" buttermilk, 60. *N12*=beef heart, 85; dry skim milk, 15. *N13*=beef liver, 75; dry skim milk, 25. *N14*=beef liver, 25; beef heart, 25; clam meal, 50. *N15*=beef liver, 50; pilchard meal, 50. *N16*=beef melts, 50; clam meal, 50. *N17*=beef melts, 50; clam meal, 25; shrimp meal, 25. *N18*=beef melts, 25; beef heart, 25; clam meal, 50. *N19*=pig liver, 50; clam meal, 50. *N20*=pig liver, 50; clam meal, 25; shrimp meal, 25. *N21*=pig liver, 25; beef heart, 25; clam meal, 50

different years or even during the same year under somewhat different conditions. Attempts to rate the various rations on a strictly statistical basis have not proved satisfactory, since there are many variable factors involved which can not be successfully subjected to mathematical analysis. Any ration to be satisfactory should result in rapid growth and low mortality, but the comparative value of these two criteria may be open to question. Both the growth and mortality have been influenced at times by the occurrence of specific infections which have necessitated the adoption of control measures. To what extent these have affected our results we have no means of determining.

In evaluating a trout food consideration must be given to the possibility that a ration which proves satisfactory under one set of

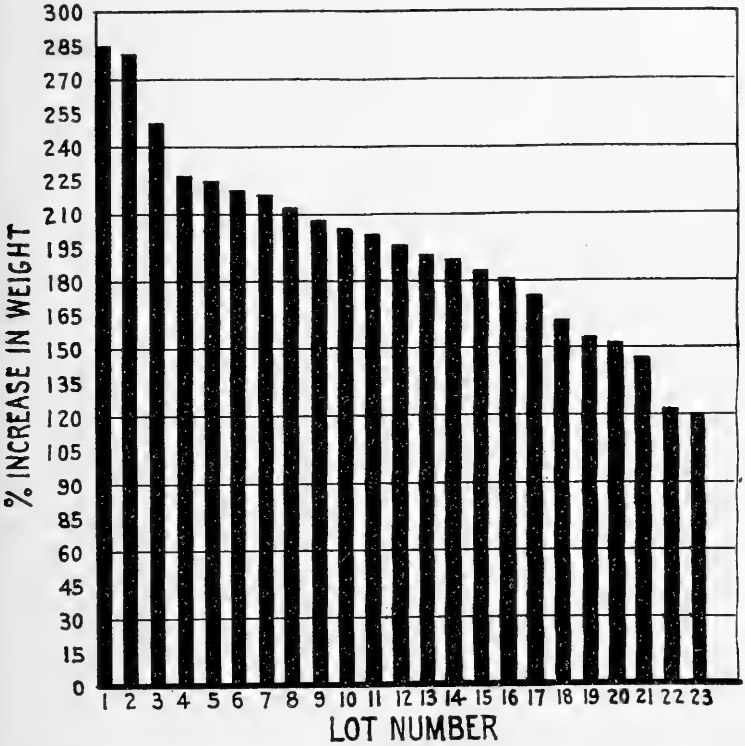

FIGURE 11.—Comparative growth of yearling brook trout on experimental rations, July 10 to September 23, 1929. The mortality in the various lots was so slight as to be of no significance. Vertical columns indicate per cent increase in weight during the course of the experiment. The rations of the individual lots were as follows: *1*=pig liver, 25; clam meal, 75. *2*=pig liver, 40; clam meal, 60. *3*=sheep plucks, 40; clam meal, 60. *4*=beef melts, 40; clam meal, 60. *5*=pig liver, 25; clam meal, 37½; shrimp meal, 37½. *6*="fox food," 100. *7*=pig liver, 100. *8*=pig liver, 25; dry buttermilk, 37½; shrimp meal, 37½. *9*=beef melts, 25; clam meal, 37½; shrimp meal, 37½. *10*=pig liver, 20; sheep plucks, 20; shrimp meal, 60. *11*=pig liver, 40; shrimp meal, 60. *12*=pig liver, 40; dry buttermilk, 60. *13*=pig liver, 50; beef heart, 50. *14*=pig liver, 40; haddock meal, 60. *15*=pig liver, 40; haddock meal, 30; shrimp meal, 30. *16*=pig liver, 25; haddock meal, 37½; shrimp meal, 37½. *17*=sheep plucks, 40; shrimp meal, 60. *18*=pig liver, 40; soybean meal, 60. *19*=beef melts, 40; dry buttermilk, 60. *20*=beef melts, 40; shrimp meal, 60. *21*=beef melts. 100. *22*=pig liver, 40; wheat middlings, 60. *23*=beef melts, 25; haddock meal, 37½; shrimp meal, 37½

conditions may not show up as well under other conditions. This is a common belief held by trout culturists and is undoubtedly true to a certain extent. It is logical to assume that where environmental conditions are exceptionally favorable less suitable rations can be fed than would be possible where the fish are handicapped by overcrowding or a poor water supply. This is probably the reason that at some hatcheries trout appear to do well on a ration which at other hatcheries has made a relatively poor showing. In such cases, however, it would probably be found that a more suitable ration would give correspondingly better results. The average trout culturist is satisfied if his fish appear to be making a good growth without excessive mortality, and he naturally chooses the cheapest food which will produce these results.

Discrepancies in results with similar rations due to age and species of fish are even more important than those traceable to environmental conditions. Our experiments indicate clearly, for instance, that many foods which are suitable for trout 4 to 5 inches long and upward are entirely unsuited to small fingerlings. Furthermore, a food which makes a good showing with one species of trout may yield very unsatisfactory results with another species. This means that each species of trout must be treated as a more or less independent problem, although no doubt in most instances quite similar results will be obtained with different species on the same ration.

In the past there has been a tendency to place too much emphasis on the nutritive elements in the food and too little on its physical consistency and palatability. It is obvious that no ration can give satisfactory results unless it can be fed with little waste and is eaten with avidity by the fish. It may contain the proper proportions of proteins, carbohydrates, fats, and other essential elements; but if it disintegrates quickly in the water or is not relished by the trout it can not fail to give unsatisfactory results. In many instances we have found that the growth and vigor of the fish are directly proportional to the amount of food they consume. Not infrequently when fish are not doing well on what theoretically should be a satisfactory diet we have found that they were eating only a portion of their food. This is especially true when using combinations of fresh meat and dry products; in many instances the fish simply pick out the meat and leave the rest. In this respect one of the most surprising results to us is that with certain combinations the fish will readily eat the entire mixture, while with others—differing only in the meat constituent—they will eat only the meat, disregarding the rest. Consequently, in making up food combinations, every effort should be made to produce a mixture which will be eaten readily with as little waste as possible.

In general, straight meat diets when properly ground are of the proper consistency to feed to trout with comparatively little waste. Different meat products, however, differ considerably in this respect and some are characterized by much more waste than others. This is especially true of liver which contains a considerable percentage of soluble constituents. Moreover, when finely ground, much of the material is carried away in suspension before the fish can get it. If it were not for this fact beef liver would probably prove to be the most satisfactory food available for advanced fry and very small fingerlings; but, owing to the lower mortality of these fish on beef heart, we consider the latter somewhat superior to beef liver. Later, as emphasized elsewhere, beef liver gives better results if not ground too fine, and in combination with beef heart appears to make an ideal meat ration.

Since beef liver is too expensive to feed to large fingerlings and older fish we must look elsewhere for a suitable meat. On the whole pig liver appears to be superior to either sheep liver or sheep plucks, especially for brook trout. Not only has it made a better showing than either of the sheep products when fed straight, but the sticky consistency of ground liver makes it an ideal binding medium for use with dry meals. Although fresh fish of the coarser and cheaper grades have been fed at hatcheries to some extent the results have not been entirely satisfactory. It usually requires twice as much fish as meat to produce an equal growth, and the trout themselves are often not as healthy as those on diets of meat. Furthermore, fish is difficult to keep fresh and the feeding of decayed fish has in some cases killed trout outright. Our experiments indicated the general unsuitability of fish, particularly as a food for brook-trout fingerlings, since its use was always accompanied by severe losses and inferior growth. It seems, therefore, that the feeding of even cheap fish in any considerable quantity to fingerlings, at least, is a matter of doubtful economy.

Our experiments clearly indicate that, with the possible exception of hatcheries which happen to be located near a local supply of very cheap meat, it is advisable in the interest of economy to feed a mixture of meat and dry products rather than to keep the fish on a straight meat diet. Since fresh meats contain from 70 to 75 per cent of water, it is evident that at from 5 to 10 cents a pound the dried products are much cheaper than even the cheapest of the fresh meats in common use. It appears inadvisable, however, to attempt the use of dry products before the fish reach a length of about 2 inches. Despite the fact that in some instances we have obtained good results in feeding dry products to smaller fish it is probable that in ordinary hatchery practice it will be better to wait until the fish are large enough to eat the mixture without its being broken up into fine particles of meat and meal. This necessarily results in considerable waste and not infrequently the meal is not eaten at all.

Even with 2 and 3 inch fingerlings the dry products which can be fed successfully are very few. First among these is clam meal; but since this product is available only in small quantities it appears that we must rely chiefly on the dried milks to replace part of the meat in the diet of fingerlings. These are the only dry products which, on the basis of our experiments, we can recommend at present, although it is probable that there are others which may prove equally valuable.

After the fingerlings reach a length of 4 to 5 inches a considerably wider range of dry foods is available. These include vacuum-dried fish meals and shrimp meal. These products do not produce as rapid growth as clam meal and the dried milks, but are considerably cheaper and can, of course, be purchased in any quantity.

Although trout can undoubtedly utilize cereals and beans to some extent, when properly cooked, we are not yet convinced that they form a valuable addition to the menu unless they are used in small amounts to serve primarily as binders. We believe that at present prices fish and shrimp meals are more economical than cereals, since in our experiments they have always given much better results than the latter.

While our experiments show that several dry meals can be successfully incorporated in trout rations it is also evident that some fresh meat in the mixture is essential. Although Thompson (1929) has reported great success in feeding dehydrated salmon eggs and also a meal composed of a mixture of dried horse liver and blood for several months without the addition of fresh meat to the diet we are still not convinced that trout can be kept on dry foods indefinitely.

In our experimental work it was found that lake-trout fingerlings started on dried shrimp meats appeared to be perfectly normal for over three weeks. At the middle of the fourth week, however, a sudden high mortality set in which was checked by the addition of 50 per cent fresh liver to the ration. The fingerlings were kept on this mixture throughout the summer with normal growth and insignificant losses.

In common with McKay and his coworkers (McKay and Dilley, 1927) we have found that dry foods alone result in stunting and excessive losses with brook-trout fingerlings. (Fig. 10.) Each lot developed characteristic symptoms, the growth falling off and the mortality rising until at the close of the experiments the only surviving fish were a few stunted, emaciated creatures, which doubtless would have died too had the ration been continued.

The methods employed at various hatcheries in feeding dry products differ quite widely. In a few instances they are fed straight, the fish being given an occasional meal of fresh meat. More often the dry meals are mixed directly with meat; and we believe that, in general, this method is greatly to be preferred. In many of our experimental rations the dry meal was moistened with hot water until it formed a thick mush before being mixed with the ground meat. However, we are now convinced that in most instances better results can be obtained by mixing the dry meal directly with the meat without preliminary moistening and we have adopted this as the standard method for use in future experiments. This method results in a somewhat more concentrated food, and the meat juices are absorbed more completely by the dry constituent. If the mixture is allowed to stand for a short time before being fed the dry particles will have become sufficiently soft to permit of their being taken readily by the fish.

As high as 25 per cent of clam meal or dry milks may be fed successfully to small fingerlings, but it is probable that a larger percentage would result in considerable amounts being wasted. With larger fingerlings and yearlings, however, a much higher percentage of meals can be used to advantage. We have not yet determined definitely the maximum amount of the dry constituent which can be safely included in trout rations. Doubtless this will vary considerably in different combinations. In some of our experiments with yearling trout we have obtained good results with as high as 60 per cent of the dry product and it is very probable that the meat constituent can be still further reduced without seriously impairing the efficiency of the ration.

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INVESTIGATIONS UPON THE DETERIORATION OF NETS IN LAKE ERIE [1]

By A. C. Robertson, *Associate Technologist, Bureau of Fisheries*, and W. H. Wright, *Late Associate Professor of Agricultural Bacteriology, University of Wisconsin*

CONTENTS

INTRODUCTION

The Great Lakes, and particularly Lake Erie, contribute appreciably to the catch of the American fisheries. In 1927, 81,326,550 pounds of fish worth $6,794,891 were caught in the Great Lakes, of which Lake Erie supplied 23,796,462 pounds, worth $1,831,284. From these data it can be seen that Lake Erie plays an important part in the fishery industries of the country. The productivity of the water is about 10 pounds of fish per acre per year,[2] which exceeds that of the other lakes. Lake Ontario, for instance, produces but 1.1 pounds of fish per acre and Lake Superior only 0.6 pound per acre. This low yield for the latter is no doubt due to the unusual coldness of its waters and the extensive areas of deep water.

The large productivity of Lake Erie makes it an excellent fishing ground. However, the cost of keeping nets in good condition constitutes a heavy expense to the fishermen. Surveys show that about $3,000,000 worth of gear is used in the "interior waters," of which a large amount (about $920,000 in 1922)[3] was used in Lake Erie. Part of this gear, such as gill nets, etc., scarcely maintains good working strength over a year's time, and the rest (trap nets, etc.) seldom lasts over three years without extensive repairs.

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[1] Appendix VIII to the Report of the U. S. Commissioner of Fisheries for 1930. B. F. Doc. 1083. Submitted for publication, Apr. 5, 1930.

[2] Fishery Industries of the United States 1926, by Oscar E. Sette, Appendix V to the Report of the U. S. Commissioner of Fisheries for 1927. Average catches for years 1913–1925, inclusive, are divided by the area of the lake in acres. The exact figures follow: Erie, 9.06; Huron, 1.64; Michigan, 1.65; Superior, 0.63; and Ontario, 1.14 pounds per acre per year.

[3] Fishery Industries of the United States, 1923, by Oscar E. Sette, Appendix IV to the Report of the U. S. Commissioner of Fisheries for 1924, p. 278.

Estimates vary as to the amount of loss suffered by the individual fisherman; it is safe to say that 10 per cent of the total expenditures must be allowed for expenses due to netting under the most favorable circumstances, and that this expense may even run as high as 50 per cent in stormy seasons, or seasons when the catch is small. The estimates of the United States Tariff Commission for 1924 (which cover data upon 28.65 per cent of the total catch of fish) place the average per cent cost of gear—excluding vessel repairs and replacements—at 17.46 per cent of the total fishing costs for the Great Lakes.[4] This report places the expense due to fishing gear on Lake Erie at 14.29 per cent of the total expenses, while the expenses of Lake Superior fisheries are as great as 21.98 per cent of the total costs The comparatively low cost cited for Lake Erie is not what one expects in view of the reported opinions on rotting of gear and the relatively high

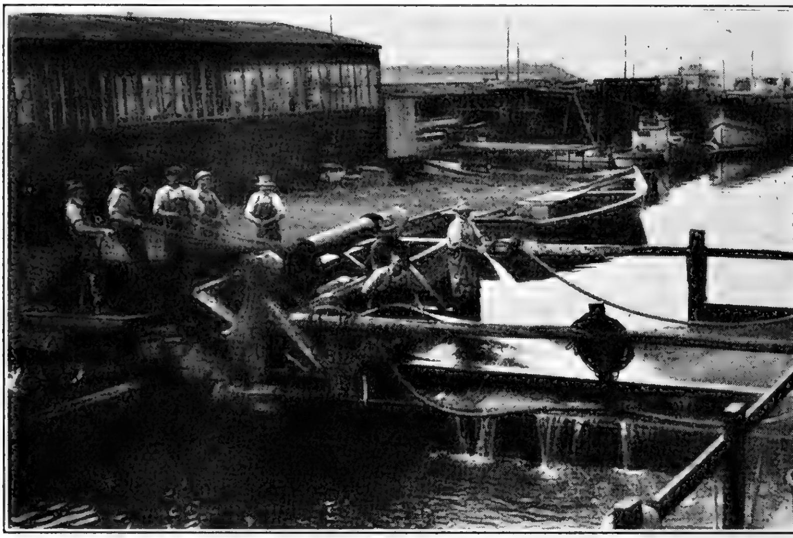

FIGURE 1.—One method used for washing pound nets on Lake Erie

water temperatures known to prevail; but when one considers that Lake Erie producers have labor and "share" costs much larger than those of the other lakes, it is apparent why the fractional part of the cost of gear may appear smaller. It would be very instructive to have more detailed data concerning the cost of nets; but, unfortunately, it is very difficult to assemble such material.

It was recognized that Lake Erie fishermen employ the greater part of the gear used on the Great Lakes, and that the ability of Lake Erie to produce its large yields of fish is due to its natural conditions favorable to fish life, such as warmth, shallowness, reaction of water, and oxygen tension, all of which combine to produce a great quantity of fish food. Funds were not available for research in 1927, but a brief field inquiry by W. T. Conn, technologist of this bureau, indicated that the damage to nets might be due to bacterial action.

[4] These data are given in their Tariff Information Survey No. 36 on "Lake Fish." U. S. Tariff Commission.

Through the cooperation and generosity of I. H. Kolbe, of Erie, Pa., arrangements were made for opening a laboratory at his plant for conducting detailed bacteriological and chemical studies when funds should be available. In the summer of 1928 it became possible to establish a laboratory at this point; Prof. W. H. Wright of the department of agricultural bacteriology of the University of Wisconsin, was associated with the bureau's workers in order that the problem might be attacked from a sound basis of microbiological experience and knowledge. J. M. Fogelberg and E. M. Hildebrand, likewise from the University of Wisconsin, performed the greater part of the experimental work with praiseworthy energy and skill.

EFFECT OF RED SLIME ON NETTING

During the summer, certain species of hydra become very abundant in Lake Erie, of which one with a red color is most common. These small animals drift about the lake, stinging the fish and driving them "wild."[5] They settle upon nets where they remain as a source of annoyance to the fishermen, whose hands often swell as a result of the irritation caused by handling the nets thus contaminated.[6] This red slime represents practically all the actual gross fouling that affects nets in Lake Erie. The growth of algæ—the green organisms found in nearly all waters—is generally not very great, though often a factor to be considered. The amount of grass and weeds is not at all comparable with the growths found at Beaufort, N. C., for instance, where luxuriant growths occur during the warm weather.

In Figure 2 will be seen a composite net made from a number of vertical strips treated with different preservatives. The treatment on the left is composed of tar applied to the twine while hot. This is the usual treatment for trap and pound nets; and the section is heavily fouled with red slime, as can be seen by comparing the size of the twine in the first section with that in the next two which are treated with preservatives containing cuprous oxide.

The fishermen believe that this red slime rots the nets. However, when one considers the mode of life of hydra this does not seem probable, for these organisms merely use the net as an anchoring place and derive their sustenance from material brought to them by the currents in the water. It was thought that possibly formic acid or a similar product caused the hydra to "sting" and that this acid might hydrolyze the cellulose of the cotton, but colorimetric measurements failed to show any great amount of acidity in a beaker of water in which hydra were allowed to rot.

In order to make sure what part is played by the larger forms of life and what part is played by the microscopic forms such as bacteria,

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[5] "July 30, 1927, commercial fishermen at St. Joseph, Mich., complain that at irregular intervals (that is, the slime does not appear every year) a red slime accumulates on their nets and after a storm it may be found in water up to 40 fathoms deep. They first noticed the red slime here 40 years ago. This slime is usually found in shallow water. They assert that this slime produces a soreness of the hands and wherever it occurs in abundance no fish can be taken. The informants assert that the slime makes the fish wild and drives them away. Gill nets fished here in the shallower water generally take whitefish, but when the slime is present no whitefish can be taken. For about two weeks this spring (1927) trout were very scarce and it was noticed that the red slime was present in abundance." Field notes by Dr. John Van Oosten.

Beardsley, in the Bulletin of the U. S. Fish Commission for 1902, Vol. XXII, pp. 157–160, records a case where hydra killed trout fry.

[6] See also W. A. Clemens, Science LV, pp. 445–6 (1922), in which is stated—"Fishermen had frequently spoken about a poisoning which often affected them while handling the nets during the process of cleaning and mending. They said this occurred chiefly after the nets had dried and were covered with a fine dust which they called tar dust. No poisioning was observed during this summer, but the men stated that their hands and faces became inflamed and swollen especially if there were any cuts."

three Mason jars were prepared with special lids. These tops had the center cut out and served to hold two disks of 200-mesh Monel metal wire cloth between which was a layer of absorbent cotton. The cotton excluded algæ and hydra but permitted bacteria to enter the jar, which contained sterilized twine. These jars were placed in the lake near the test racks. At the end of two weeks a jar was recovered and the contents examined. Many bacteria were found but no algæ, protozoa, or other larger plankton organisms (the name commonly applied to freely floating forms of life). At this time the strength of the twine had decreased very little. At the end of a month a second jar was opened and examined. Several examinations showed nothing but bacteria present, proving the filter had done its work in excluding larger organisms. The twine from the second jar was dried; it was found to be so rotten that no tensile strength determinations were made.

FIGURE 2.—Composite net showing differences in fouling on test panel near a pound net. The strip nearest the fisherman's hand is tarred; the others are treated with cuprous oxide treatments

From these experiments it was concluded that red slime did not harm nets markedly, since the twine in the screened jars rotted quite as fast in the absence of hydra as the other twine did in the presence of these organisms. Experimentally, it is almost impossible to grow hydra in the absence of bacteria, hence the effect upon cotton of red slime alone was not tested. It is thought on the basis of the foregoing experiments, that the only probable harm resulting from hydra is the increased bacterial action caused by these organisms affording the bacteria a safe place for growth.

EFFECT OF BACTERIA ON NETTING

Description of attacking bacteria.—In order to learn what part bacteria played in the rotting of nets, some slime was taken from a pound net and examined with the microscope. Numerous bacteria were present and so steps were taken to grow these organisms in the laboratory. A drop of slime was put into a test tube containing some twine and a nutrient solution which was known to favor the growth of cellulose-attacking bacteria more than the growth of organisms which utilize other material for food. In a short time the nutrient solution clouded, there was formation of membranes on the surface and of gas bubbles, all of which indicated vigorous growth of the "planted" organisms.

The next step in isolating these organisms was to transfer some of the culture to an agar culture medium containing finely divided cellulose and special nutrient material, the purpose of which was to favor the growth of the bacteria in which we were interested.

The culture medium used was that recommended by Dubos (1928) and consisted of: Sodium nitrate (Na NO_3), 0.50 grams; di-potassium phosphate K_2HPO_4, 1 gram; magnesium sulphate (Mg SO_4 $7H_2O$), 0.50; potassium chloride (KCl), 0.50; ferrous sulphate (Fe SO_4 $7H_2O$), 0.01; and distilled water, 1,000 cubic centimeters. The reaction was pH 7.3.

Later experiments have shown that ammonium sulphate serves better than sodium nitrate. Apparently some or all of the organisms are facultative anerobes and resist higher oxygen tensions when, ammonium salts are supplied as nutrients.

The use of cellulose agar was suggested by the work of McBeth and Scales (1913). The preparation of cellulose with the copper treatment was not satisfactory, and a much better preparation was made by dissolving 75 grams of very pure absorbent cotton in 16 cubic centimeters of 72 per cent sulphuric acid, precipitating by diluting, and then washing thoroughly. The agar medium was made by adding 1 per cent by weight of the suspended cellulose and 1.5 per cent agar to Dubos medium.

The mixture was poured into Petri dishes and allowed to incubate at 25° C. for several days. At the end of 10 days the surface of the agar was examined. A number of colonies of bacteria were found,[7] but not all of them were the same in appearance. Some had clear zones around them in the otherwise cloudy agar, showing that they had removed the suspended cellulose for use as a foodstuff. The colonies grew until the fourteenth day but remained small, though they were active enough to remove the cellulose from large areas surrounding them. Two typical plates 18 days old are shown in Figure 3. The cellulose-digesting bacteria from these colonies were examined under the microscope, and some of them were transferred to test tubes to prepare cultures for later experiments upon preservative treatments.

Morphology of the bacteria.—The organisms most commonly observed in the decomposed cotton fibers and in cultures prepared for study, were round-ended rods 1.3μ to 2.6μ by 0.4μ occurring singly. The cultures give a microscopic picture which suggests that there are other organisms present. This is indicated by the size of the rods and their reaction to the Gram stain, which may be either positive or negative. In hanging drop preparations some of the organisms appear to be motile but most of them give no indication of vital movement. Flagella could not be demonstrated with the Caesares-Gil stain. No spores have been observed. There is often present

[7] The occurrence of halo-forming bacterial colonies in the agar was not completed at 10 days, for other colonies put in their appearance at 11, 12, 13, and 14 days.

some slimy material but no particular indication of capsules. As long as the purity of the cultures is in doubt, it is impossible to determine definitely the morphology of the organisms. (Several reisolations of these cultures are being studied at present.)

The best stains are carbol-erythrosin (Conn) and carbol-fuchsin. The former requires about 10 minutes to stain and the latter 30 seconds to 1 minute. Carbol-erythrosin is supposed not to stain foreign matter to any great extent but to be specific for bacterial protoplasm.

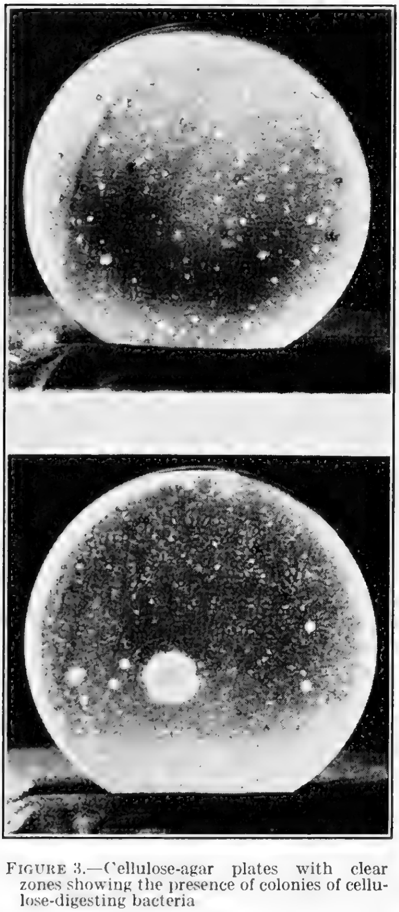

FIGURE 3.—Cellulose-agar plates with clear zones showing the presence of colonies of cellulose-digesting bacteria

Colony formation and growth characteristics.—On cellulose agar plate cultures there are a number of characteristic colonies that regularly appear. A white colony with a rhizoid appearance under the microscope, a finely granular internal structure, generally less than 0.5 millimeter in diameter, and surrounded by a halo of clear agar where the cellulose has been dissolved; a white punctiform colony also about 0.5 millimeter in diameter, undulate edge, and finely granular internal structure which also causes cellulose to be dissolved; a yellow chromogenic colony generally appearing as a football-shaped deep colony that sometimes breaks through the surface and grows sparsely in a round colony—the deep colony has a finely granular structure, and the surface colony looks rolled up like globules of yellow fat on a wet surface. In plate cultures of the more active impure liquid cultures one may find many other forms which need not be described. When slants are inoculated from plates, in general, the growth is so light, if there is any at all, that it is hardly characteristic.

None of the ordinary methods for obtaining pure cultures of these bacteria was successful. They do not grow well on solid media and seem to lose their power to ferment cellulose; accordingly the method of picking colonies off plates has not yet worked successfully. However, there is no basis for the belief that these bacteria can not grow on cellulose agar. The only limitation seems to be that the active culture media should be streaked across the surface rather than broken up into separate colonies. If the first procedure is adopted an inoculation from the growth on agar into fresh media will cause fermentation, whereas if the separate colonies are picked off and inoculated into fresh media growth occurs but no cellulose fermentation. As has been mentioned, however, in the paragraph on colony morphology there are halos around single colonies which indicate that cellulose is being fermented. Except for the last fact one would be inclined to believe the action an associative one. The inconsistency might be explained by assuming that the colonies with halos around them are impure or that other colonies near them were secreting an enzyme which aided them to ferment cellulose. The frequency of the occurrence of yellow colonies when active cultures are plated out and the presence of a yellow precipitate at the bottom of active liquid cultures would lead one to suspect that this chromogenic organism had something to do with the cellulose fermentation.

The yellow colonies, which all seem to have the same colony morphology, grow but sparsely on cellulose agar. In shaken cultures it is apparent that their oxygen requirements are very definite—

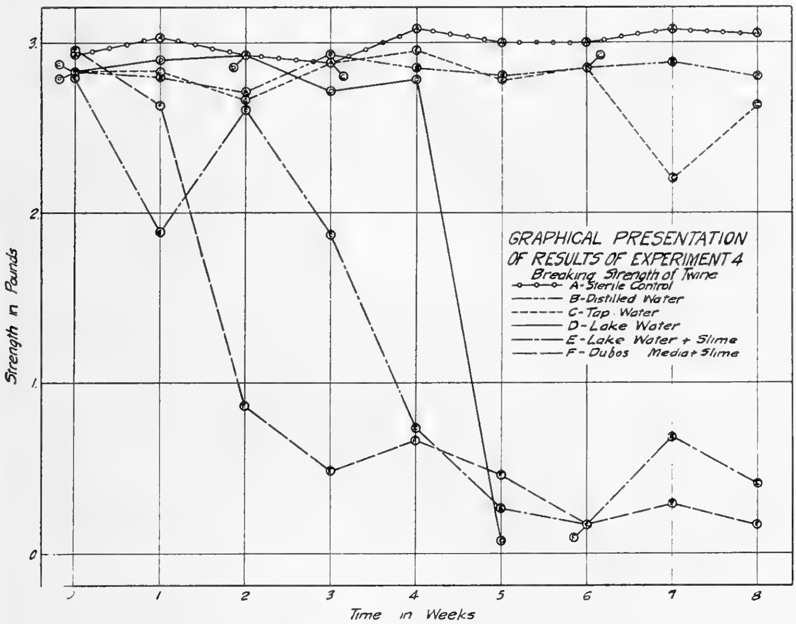

FIGURE 4.—Breaking strength of twine in experiment 4

slightly below the concentration of the atmosphere. If they were associated in the fermentation, its nearly anærobic character would be explained.

The cultures seem to lose gradually their power to destroy paper at the surface of Dubos media. This could be explained in one of several ways: (1) That the cellulose of paper is different from that of twine and more difficult to attack, and the power to attack it is lost more quickly than the power to attack cotton fibers; (2) that the nitrogen found in the lumen of the cotton fiber is helpful for bacterial growth and hence causes the cotton to be fermented more readily; (3) that there are two distinct kinds of organisms acting in our cultures—one ærobic which quickly loses its power to ferment cellulose in culture media and one facultative or slightly anærobic form which can be cultured more easily. The results of the experiment with shaken cultures would seem to bear out the latter view. Apparently a very low oxygen tension is unfavorable to the organisms, for there is no evidence of growth either in the closed arm of a fermentation tube or in a special anærobic culture media containing reduced iron and an oxidation-reduction indicator.

The bacteria can use either ammonium sulphate or sodium nitrate as a source of nitrogen. When nitrate is used, after four weeks the media give no test for either nitrates or nitrites. This would indicate either that denitrification was taking place or that the nitrogen of the nitrate was being used to synthesize bacterial protein. There would hardly seem to be enough growth to support the latter hypothesis. This should be investigated for there has been reported by Gerretson and also Groenwege a symbiotic relation between two organisms which results in denitrification and cellulose fermentation.

The bacteria involved in the preceding fermentation are apparently not the same as those involved in the rotting of wood. Organisms living at temperatures close to blood-heat, or greater, have been isolated from well-rotted samples of dry wood, but as yet no organism thriving best at room temperatures has been found in such material.

It has been found that solutions of crystal violet of 1/100,000 concentration do not completely inhibit the growth of our culture of cellulose fermenters while concentrations of 1/75,000 do.

TABLE 1.—*Appearance of gill-net twine cultures*

Date	Source of inoculation material					
	Sterile control	Distilled water	City water	Lake water	Lake water and slime	Culture media and slime
July 13, 1928	Sterile	Slightly cloudy	Cloudy	Very cloudy	Very cloudy	Very cloudy.
July 20, 1928	do	Slightly cloudy, few bacteria.	do	do	Very cloudy, slime, odor	Very cloudy, slime, odor,
July 27, 1928	do	Cloudy, precipitate, few bacteria.	Cloudy, many bacteria	Very cloudy, many bacteria	Very cloudy, slime, odor, many bacteria.	Very cloudy, slime, odor, many bacteria.
Aug. 3, 1928	do	Cloudy, few bacteria	do	Very cloudy, slime forming	do	Do.
Aug. 10, 1928	do	do	do	Very cloudy, slime forming, many bacteria, odor.	do	Do.
Aug. 17, 1928	do	do	do	do	do	Do.
Aug. 24, 1928	do	do	do	do	do	Do.
Aug. 30, 1928	do	do	do	do	do	Do.
Sept. 7, 1928	do	do	do	do	do	Do.

Occurrence of the bacteria.—Having found that bacteria are present in the slime deposited upon pound nets and that these bacteria digest cellulose, it was deemed advisable to study the occurrence of the organisms. Samples of sterilized gill-net thread, number 70/6 cord, were placed in test tubes containing distilled water, tap water, and lake water, respectively. These media were chosen to see how much of the contamination was water borne. In another series, other test tubes were filled with Lake Erie water plus 1 cubic centimeter of slime from nets, and with Dubos medium plus the same amount of slime, respectively, so that a comparison could be made concerning the effectiveness of lake water and an artificial medium in propagating the bacteria. Some twine was sterilized in a test tube containing distilled water in order to obtain an idea of the changes taking place in the absence of bacteria.

At the end of a week, and each week thereafter, samples were removed, dried, and broken in the testing machine. The results of these tests are shown in Figure 4 and Table 1, where it is seen that the sterile control suffered no appreciable change in the two months and that the distilled water and tap water were almost without effect.

This experiment indicated that the city water was not a source of contamination. The results also show that lake water is an excellent

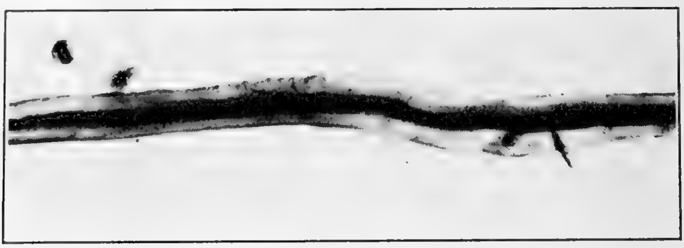

FIGURE 5.—Normal cotton fiber in sterile distilled water

medium for the growth of the cellulose-digesting bacteria, though the growth is not as rapid at first as in the artificial medium of Dubos. The latter preparation was used in subsequent experiments since it was reproducible and easily available if laboratory work were to be done elsewhere than at Lake Erie.

The lake water inoculated with slime caused the twine to rot until half its strength was gone in about 23 days; inoculated Dubos medium required only 11 days to bring the twine to half-strength; and surprising to note, the lake water without added contamination took but 32 days. These tests must not be construed to mean that nets will rot this rapidly in practice, for laboratory conditions are not exactly comparable with those in nature. These data do, however, allow one to compare in a rough way the effect of the various conditions being investigated.

Bacterial action on the individual fiber.—The cultures were examined microscopically and found to contain may bacteria of various forms, expecially very short rods occurring in pairs and ones having a spiral shape. Fibers of the test twine were placed under the microscope and were observed to contain many bacteria. A number of photographs are shown in Figures 5 to 8. In order to understand them it is necessary to describe a cotton fiber briefly. Imagine outside pressure applied to a very heavy walled rubber tube which thereby collapses and thus acquires a cross section somewhat dumb-bell-like in form. The wall

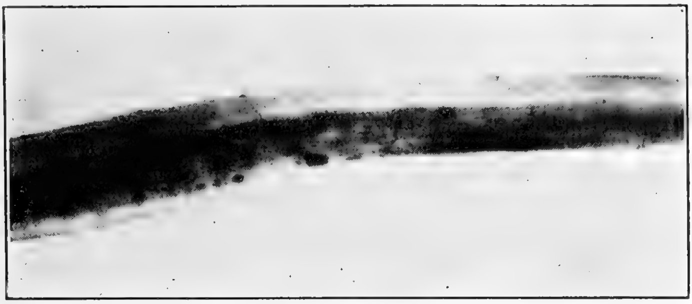

FIGURE 6.—Cotton fiber in nonsterile tap water. Decomposition has started

of a cotton fiber varies in thickness and is most often without structure, though pits and pores are sometimes visible. The interior of the fiber

FIGURE 7.—Cotton fiber in lake water plus slime from nets. Numerous bacteria are present

is lined with dried protoplasm, which may serve as a food for bacteria penetrating within.

FIGURE 8.—Same as Figure 7 except in Dubos medium. The bacteria have penetrated the lumen of the fiber and destruction is practically complete

The air-filled lumen appears dark in the pictures until enough deterioration takes place to allow water to enter and fill the gap, where-upon the passage of light is not impeded as much as before. In stained specimens, the dye colors the protein-bearing material (protoplasm) within the lumen and renders it dark, especially on the sides where the lumen is thickest. Owing to the thickness of the fiber, it is difficult to render the structure of the fiber extremely clear, but in Figure 6 it can be seen that the cotton hair placed in tap water for a short time appears greatly different from the normal fiber. A cotton hair from the sample placed in lake water which had been inoculated with slime shows deterioration far advanced, while a similar sample in Dubos medium is already badly disintegrated. One should notice that the width of decomposing fibers is greater than that of unattacked hairs, indicating again the destructive and disintegrating effect of the attacking organisms.

Several methods were tried for preparing fibers for examination. The swelling test used by Thaysen and Fleming (1921) and coworkers is altogether too delicate to use on fibers that have been extensively damaged by long use or by tests in the laboratory. This test would have a great value in testing the quality of cotton offered for sale in the form of fishing gear. The Congo Red test of Bright (1926) is useful for detecting the first degenerative changes, being less delicate than the previous one; but this method is also too sensitive for the preparation of material badly attacked and digested by the bacteria.

The method finally adopted was simple. It was to mount and fix a few fibers as for simple bacteriological staining and then to treat with carbol-fuchsin for 20 to 30 seconds. Fibers which have suffered extensive change are handled most satisfactorily by using a diluted carbol-fuchsin and watching the progress of the staining. The cuticle does not show clearly—a decided disadvantage since otherwise a picture of the mode of entrance of the bacteria might be obtained. It does not seem as if any method will be found to do this. It is probable that the function of tars, incorporated in the various treatments used in the bureau's experiment, has been to cover over the cuticle of the cotton fiber with a substance resistant to bacterial attack, thereby delaying invasion of the fiber by the organisms found in the water.

When the tensile strength of the test threads began to decrease rapidly, it was always found by microscopic examination that the bacteria had penetrated the walls of the individual fibers and that the two events were simultaneous. The fibers begin to swell after entry is effected; this swelling is accompanied by a notable increase in the number of the bacteria within the lumen and a wasting away of the fiber from within until destruction is complete.

Distribution of the bacteria and their environment.—In order to learn the relative abundance and distribution of the bacteria a number of samples of water were taken at fishing locations. These were obtained by means of a bacteriological water sample apparatus, Wilson (1920). With this apparatus sterile evacuated and sealed 8-inch test tubes were lowered to a predetermined depth. A messenger was then sent down to break the tip of a bent-glass tube which projected through the rubber stopper. The broken tip allowed the entrance of water to the container, which was then drawn up and taken to the laboratory where measured quantities of the water were introduced into tubes containing Dubos medium and cotton gill thread. The subsequent deterioration of this gill thread week by week is shown in Figure 9 which shows the results of weekly determinations of the tensile strength of the thread. The history of one sample shows the large amount of bacteria found in slime, which must therefore be considered a most dangerous source of contamination to clean nets. It is to be noted that contamination can take place far from shore and in water as deep as 10 fathoms. The bacteria attacking the nets are apparently found in all locations in the lake, but occur in largest numbers near shore,

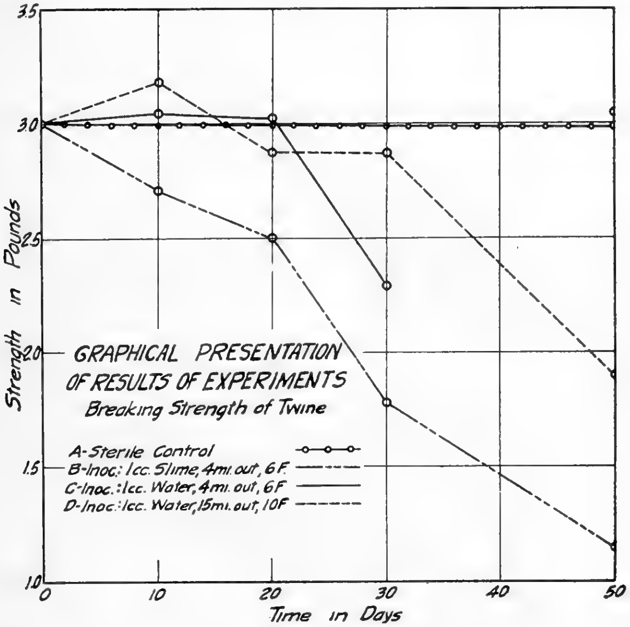

FIGURE 9.—Breaking strength of twine

where the water may contain as many as 500 per cubic inch. They are most numerous in the slime found on nets or similar anchorages and least frequent in the open lake, where their food is not as easily available and agitation of the water is less marked.

The remaining portion of the lake water collected from known locations under aseptic conditions was used for determinations of reaction and dissolved oxygen, given in Table 2. Note that the oxygen content expressed here in parts per million, is high and relatively uniform. This and the high temperature of the water is due to the shallowness of Lake Erie.

TABLE 2.—*Temperatures, oxygen content, and reaction (pH) of Lake Erie water at locations where nets were set*

Date	Course and distance from Erie	Depth	Temperature	Oxygen, parts per million	pH	Remarks
1928			°C.			
Aug. 15	N. by E. 16½ miles[1]	Surface		8.5		Thermometer and pH outfit not available.
		15 fathoms		8.5		
		23 fathoms[2]		8.8		
Aug. 16	N. by E. 16 miles[1]	Surface		8.4	8.4	
		12 fathoms		8.4		
		24 fathoms[2]		8.9		
Aug. 17	N. by E. ¼ E. 16 miles[1]	Surface		8.0	8.4	
		13 fathoms		7.7		
		22 fathoms[2]		9.4	8.1	
Aug. 21	N. by W. ½ W. 14 miles[1]	Surface		8.3	8.4	
		14 fathoms[2]		7.8		
Aug. 22	N. by W. ½ W. 15 miles[1]	Surface		8.3	8.3	
		13 fathoms[2]		8.3	7.7	
Aug. 28	N. ¼ E. 8 miles[1]	Surface		8.4	8.2	Unusual for gill nets to be fished so near shore.
		13 fathoms[2]		6.6	7.9	
Sept. 7	N. ¼ E. 16 miles[1]	Surface	18.5	8.8	8.0	Thermocline between 16 and 21 fathoms.
		11 fathoms	18.2	8.7	7.8	
		21 fathoms	8.8	9.1		
Sept. 8	N. 16 miles[1]	Surface	19.3	8.7	8.0	
		11 fathoms	17.4	8.8		
		19 fathoms[2]	11.2	9.1		
Sept. 15	N. ½ E. 14 miles[1]	Surface	19.7	8.7	8.2	
		9 fathoms	18.5	8.7		
		18 fathoms	9.5	9.2	8.0	
Sept. 6	3 miles from harbor[3]	Surface	21.1	8.5	8.1	
		4 fathoms	20.2			
		7 fathoms	20.0	7.9	7.7	
Sept. 14	do[3]	Surface	20.9	8.5	8.2	
		7 fathoms	21.2	8.2	7.9	

[1] Gill nets. [2] Bottom. [3] Pound nets.

As a random experiment small pieces were cut from some dried gill nets, which had been out of the water for a period of time between one and two weeks, and put into Dubos medium for incubation. At the end of several days bacterial growth was noticed, and the usual bacteria were found by microscopic examination. Transfers were made from this culture to other tubes of media, which produced some of the most active cultures found in the work. The conclusion follows that contaminated nets handled in the accepted way still harbor destructive organisms for some time. The bacteria may slowly continue to cause deterioration during the period of winter storage until the nets become so dry that the organisms die.

The part played by bacteria during the months when the nets are not being used should be investigated further. It seems probable that much deterioration can take place unless the nets are clean and dry at the time they are put away for the winter.

PRESERVATIVE TREATMENTS

Bacteria differ with respect to the kind of food they thrive upon best. Some utilize meat, others starch, sugar, or fat. The bacteria in which we are interested utilize cellulose as their favorite food. It is the process of converting the cellulose so generally found in the lake that makes the bacteria injurious to net twine. As long as the cellulose is derived from débris of wood or rotting grass, this process does not concern the fisherman; but unfortunately the thread of gill nets can also serve these bacteria as food. Not only do the bacteria feed on the fibers of the net, but they also find the threads an excellent home, since the currents passing by wash away waste products and bring to the germs foodstuffs needed to supplement the cellulose. Then, too, the interior of the cotton fiber contains nitrogenous material, always vital for life. Study has shown that the net-destroying bacteria found in Lake Erie are the type that can live in the presence of oxygen but thrive best when only a small amount of oxygen is present. Other cellulose-destroying organisms live only in the absence of air, as in the case of those inhabiting the soil and the digestive tracts of herbivorous animals, and hence do not generally constitute a source of danger when washed into the oxygen-bearing waters of the lake.

With the aid of general knowledge concerning bacteria and the specific facts concerning these particular organisms it is possible to describe briefly ways of fighting them. Inasmuch as bacterial growth is greatly decreased or actually stopped by lack of moisture, fouled nets can be safeguarded by washing away most of their contamination and killing the rest by drying the net thoroughly. When sunlight is available, its helpful rays add to the efficiency of the treatment. Unfortunately this simple though effective treatment can be used only once in a while. A second simple treatment is the use of a strong brine solution. This kills bacteria by removing water from their bodies. They shrivel in brine just as strawberries do when much sugar is used for their preservation. Then, too, alkaline materials kill bacteria quickly. A clear lime-water solution may be used on the nets to "cut the slime" and to stop bacterial action.

Other germicides are known but they are generally rather expensive for practical use and just as transient in their effects as those which are cheaper. Therefore, one finds it necessary to search for relatively insoluble germicidal materials and finds that there are a number, of which cuprous oxide, copper oleate, and mercuric oxide are cheap with respect to their usefulness.

These materials have been tried before; copper resinate undoubtedly will replace copper oleate because it has about the same solubility, is cheaper, not as slippery, and is more adherent to the fibers. Any other copper salt of an organic acid of molecular weight over 200 and possessing no unsaturation will possibly serve as well. Since resin acids constitute about 90 per cent by weight of rosin and since the latter product is cheap, no further search for suitable copper salts seems necessary.

Cuprous oxide must be finely ground, 95 per cent passing through a screen having 350 meshes per lineal inch, and may be further improved in evenness of application and in the slow-settling nature of its mixture by grinding still finer, as in a colloid mill.

Tars are effective as germicidal treatments until the active ingredients wash out, which probably takes place in two months, after which they offer mechanical protection only. The use of tar has been abandoned in the work undertaken by the bureau's technologists except as a "vehicle" to hold the toxic material upon the fiber.

TESTS OF PRESERVATIVE TREATMENTS IN THE LABORATORY

Laboratory experiments were made in order to test net-preservative treatments rapidly and under rigorously controlled conditions. It was realized that factors such as the leaching out of toxic ingredients in the treatment would not be the same as in the lake. Moreover, the supply of food to the bacteria and the removal of their waste products would not be ideal, and hence the bacterial population would not reach a very high level. The results, therefore, could only be expected to be qualitative. Nevertheless, the experiments were initiated and carried through. The results are shown in the following table. The first column indicates the effect of the treatment, cold, upon previously sterilized twine; columns 2 and 4 show the effect of bacteria upon twine previously treated with the material under study, then sterilized in an autoclave, and finally inoculated with destructive bacteria. Columns 3 and 5 show the effect of sterilization upon the treated twine.

Table 3.—*Effect of preservatives on gill-net twine under laboratory conditions*

Description of treatment	Tensile strength in pounds				
	Chemical effect of treatment	Inoculated with bacteria in Dubos media	Treated and sterilized in Dubos media	Inoculated with bacteria in lake water	Treated and sterilized in lake water
Untreated control	3.00	0.91	2.78	2.88	2.95
Tannic acid, 1 per cent; copper sulphate, 10 per cent	2.30	2.17	2.12	2.24	2.20
Tannic acid, 1 per cent; phenol, 5 per cent; ferrous sulphate, 10 per cent	2.83	2.73	2.71	2.63	2.63
Salicylic acid, 10 per cent in cupric chloride dissolved in ethyl alcohol 10 per cent	2.88	2.98	1.86	2.95	1.94
Zinc sulphate, 10 per cent	2.98	2.95	2.71	2.34	2.78
Tannic acid, 1 per cent; cupic chloride, 10 per cent	2.27	1.81	2.30	2.37	2.24
Lead acetate, 10 per cent; potassium dichromate, 10 per cent	1.67	1.52	1.52	1.79	1.45
Tannic acid, 1 per cent; cupric acetate, 5 per cent	2.47	2.30	2.60	2.54	2.40
Copper sulphate, 10 per cent; sodium carbonate, 10 per cent	1.84	2.30	2.15	2.20	1.79
Cresote (beechwood), full strength	3.13	.83	2.93	1.83	3.10
Phenol, 5 per cent; crystal violet, 1:1,000	2.95	2.90	2.90	3.00	2.98
Phenol, 5 per cent	2.90	2.90	2.90	3.03	2.98
Beta naphtol, 10 per cent in alcohol	2.90	2.88	3.03	2.80	3.15
Cupric chloride, 10 per cent; potassium dichromate, 10 per cent	1.18	1.13	1.29	1.11	1.01
Cupric chloride, 10 per cent; sodium carbonate, 10 per cent	1.32	2.15	1.92	1.83	1.65
Beta naphtol, 10 per cent in alcohol; cupric chloride, 10 per cent	2.78	2.85	2.15	3.08	2.63
Proprietary compound	3.22	3.17	2.93	3.63	3.08
Tar-kerosene	3.13	2.00	3.08	3.05	3.15
Cuprous oxide, 6 per cent; coal tar, 6 per cent; pine tar, 3 per cent; water-gas-tar oil, 85 per cent (treatment No. 2850)	3.10	3.10	2.83	2.83	3.10
Crystal violet 1:1,000	3.10	3.13	3.15	3.10	2.95
Cuprous oxide, 6 per cent; coal tar, 20 per cent; water-gas-tar oil, 74 per cent (treatment No. 284)	3.30	3.31	3.15	3.19	3.10
Cuprous oxide, 6 per cent; coal tar, 13⅓ per cent; pine tar, 6⅔ per cent; water-gas-tar oil, 74 per cent (treatment No. 288)	3.33	3.19	2.93	3.31	3.10
Copper resinate, 29 per cent; water-gas-tar oil, 71 per cent (treatment No. 2817)	3.08	3.31	3.29	3.63	3.48
Mercuric oxide, ¾ per cent; ferric oxide, 6 per cent; coal tar, 13 per cent; wood tar, 7 per cent; water-gas-tar oil, 73 per cent (treatment No. 2819)	3.27	3.38	3.15	3.45	3.33

The treatments tested include many not heretofore used. Some are not suitable for practical use upon nets, but were tried in order to learn more about the characteristics of the cellulose-digesting bacteria.

It appears that phenol affects the bacteria adversely; however, it can not be used on account of its solubility. Betanapthol is effective, but creosote has little effect. The inefficiency of creosote for this purpose agrees with findings in other fields, which show this material to be very effective in preventing putrefaction but rather weak as a germicide. The dye, crystal violet, is effective, and its potency suggested experiments as yet uncompleted which show that favorable results might be expected from materials of this sort. Dyes can be used when solids such as cuprous oxide or tar, for instance, are so bulky and inflexible as to reduce the "fishing power" of gill nets.

It is interesting to note that these experiments show that treatments containing oxidizing agents, such as chromates or alkalies, are inapplicable to nets. The reason for these results is that alkalies destroy the cutin which otherwise protects the cellulose of the cotton fiber from hydrolysis and bacterial attack, thus weakening the fiber, and that chromates destroy the fiber by reason of their oxidizing power.

Good results were obtained from all treatments selected from those originated by this laboratory and from a commercial preparation which probably consists of copper salts of napthenic acids. It would appear that the method using single inoculations is not severe enough to show sufficient differences in the strength of the best preservatives in a short time. Experiments are now being conducted by an employee of the bureau at the University of Wisconsin in order to make the laboratory controlled test more rapid. This is most valuable since any laboratory procedure which will enable one to sort out and place various treatments in rank of usefulness, will accomplish in three or six months what would otherwise take one or two seasons in nature's laboratory, where storms or other uncontrollable forces often interfere with or ruin experiments.

TESTS OF PRESERVATIVE TREATMENTS IN THE LAKE

A number of racks were wound with samples of treatments selected from those which had previously shown promise in tests at Beaufort, N. C. These racks were immersed in 6 fathoms of water 4 miles out of Erie Harbor, and samples removed at weekly intervals. The samples were later broken in the testing machine, and duplicate samples were analyzed to see how the copper content of the twine had changed.

The analysis of treated fish netting for copper is not very easy nor is it rapid enough, when using methods previously employed, to admit of sufficient samples being analyzed so that the results of the determinations are significant.

The method which was finally evolved and found to be satisfactory was a modification of the Kjeldahl method. One foot of treated twine was used for each determination. This was obtained by cutting four 3-inch lengths from different places in the twine so as to secure an average sample. The twine was then weighed, cut into short lengths, and placed in a Kjeldahl flask. From 5 to 8 cubic centimeters of concentrated sulphuric acid was added; and the material was digested for a short period or allowed to stand for a time, depending on whether heating facilities were available. After this preliminary digestion the flask was cooled, and a very small amount of concentrated nitric acid was added. Treatments containing little tar, or those which had been exposed for a long time, required little of the oxidizing agent; but those which were new or which contained much tar required more nitric acid. The flasks were then heated very gently until the action of the nitric acid ceased, after which they were heated more strongly until digestion was complete and SO_3 was evolved.

The solution at this point became nearly colorless. Samples containing much copper of course would color the acid slightly blue; and those which contained siliceous material or much mud would have a slight sediment remaining when digestion was complete. The solution should not show a yellow or brown color. If it did, it was cooled and

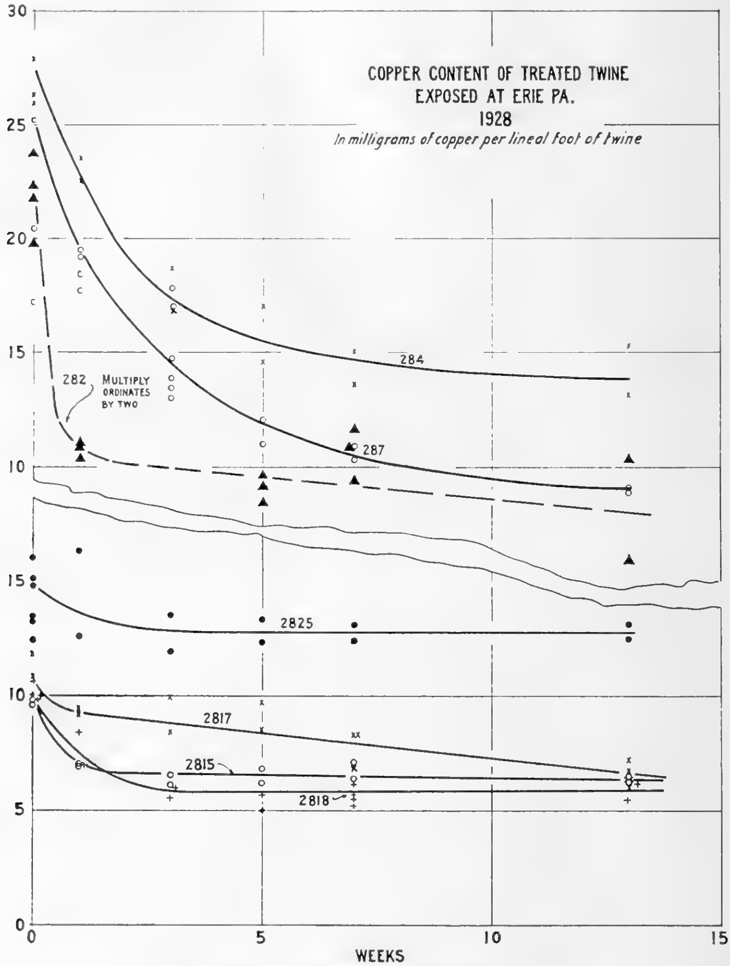

FIGURE 10.—Copper content of treated twine

treated with concentrated nitric again, and the process repeated until the solution became colorless or blue-green. After a colorless solution was obtained, it was cooled and 5 or 10 cubic centimeters of water added so as to dissociate the nitrosylsulphuric acid which was formed from the decomposition of nitric acid, and about 5 cubic centimeters of bromine water was added to destroy nitrous acid. The flask was then heated until the solution was evaporated to small volume and white fumes of SO_3 were given off. The flask was allowed to cool, the contents diluted with water and neutralized with concentrated sodium hydroxide solution. The point of neutralization can be determined by noting the precipitation of copper hydroxide.

The contents of the flask were cooled again, transferred to a beaker, made acid to litmus with acetic acid, and solid potassium iodide added. The liberated iodine was titrated with standard sodium thiosulphate solution, using starch as an indicator in the usual manner and observing the usual precautions for this method. The sodium thiosulphate was standardized against metallic copper, repeating all the steps of the usual procedure, and the factor calculated directly in terms of copper per cubic centimeter of thiosulphate solution. Care should be taken to examine the sodium hydroxide used in this determination to make sure that it is free from iron and copper. No trouble was encountered on this score in this work, however.

The analytical determinations were quite satisfactory as regards accuracy and speed. In previous work the sample had been prepared by burning the twine in a crucible. This procedure is sufficiently satisfactory when only one or two determinations are necessary but does not give good results when a large number of samples are to be examined for the reason that the process of ashing is slow and each sample has to be watched carefully during this process of ashing lest material be lost. Pyrosulphate fusions and sodium peroxide fusions were tried but did not give any better results than simple ashing with regard to loss of material in the process of destroying the organic matter.

TABLE 4.—*Tensile strengths and copper content of treated twine exposed at Erie, Pa., 1928*

No.	Initial		1 week		3 weeks		5 weeks		7 weeks		13 weeks	
	Tensile strength	Copper content	Tensile strength	Copper content	Tensile strength	Copper content	Tensile strength	Copper content	Tensile strength	Copper content	Tensile strength	Copper content
	Lbs.	*Mg. per lin. ft.*	*Lbs.*	*Mg. per lin. ft.*	*Lbs.*	*Mg. per lin. ft.*	*Lbs.*	*Mg. per lin. ft.*	*Lbs.*	*Mg. per lin. ft.*	*Lbs.*	*Mg. per lin. ft.*
281	40.5		52.3		46.4		35.4		15.3		5.9	
282	38.8	44.6	46.3	20.7	54.6		53.8	19.2	49.2	23.5	45.5	15.8
		47.7		22.0				18.3		18.7		20.8
		43.5		21.8				16.8		21.8		
		39.5										
284	40.4	26.3	53.4	22.5	56.6	16.9	55.9	14.6	43.0	13.6	39.4	13.2
		25.9		23.5		18.7		17.0		15.0		15.3
		27.9										
287	43.8	17.2	47.1	17.7	55.6	13.0	49.3	12.0	45.8	10.3	33.9	8.9
		20.4		19.2		13.8		11.0		10.9		9.1
		25.2		18.4		13.4						
				19.4		14.6						
2811			41.9		56.7		56.8		55.4		42.5	
2815	40.5	9.6	43.5	7.0	46.9	6.5	46.9	6.8	46.6	7.1	44.9	6.5
		9.8		6.9		6.1		6.2		6.4		6.3
2817	47.7	11.8	47.5	9.2	55.1	8.4	53.9	8.5	51.7	8.3	57.7	6.7
		10.8		9.4		9.9		9.7		8.3		6.4
										6.9		6.0
												7.2
2818	47.6	9.8	48.3	7.0	53.6	6.0	53.9	5.0	54.6	5.5	55.2	5.6
		10.7		8.4		5.6		5.7		5.2		6.3
		10.0								5.7		
		9.9								6.2		
2819	46.6		49.2		57.8		53.2		54.4		46.8	
2825	46.7	13.2	47.4	16.3	55.0	13.5	52.5	13.3	50.1	13.1	46.0	12.5
		13.4		12.6		11.9		12.3		12.3		13.1
		14.8										
		16.0										
		15.1										
		12.4										

By using the modified Kjeldahl digestion method the analyst is able to handle many samples, the number depending on the facilities available for Kjeldahl digestions. The process of digesting requires the minimum of attention and the analysis of the prepared solutions can be conducted during its course.

Some samples, notably those which contain the most tar, took as long as two hours to digest; but most of the samples required about one-half hour. By planning the work carefully it was possible for an analyst using this procedure to analyze 10 to 15 duplicate samples a day, making a total of 20 to 30 determinations. This progress would be impossible if each sample had to be destroyed by ashing.

The tabulated results are shown in Table 4. The results of the analytical determinations are plotted in Figure 10 with the copper content of the twine in milligrams per lineal foot as abscissæ and the time in weeks as ordinates. The data for the tensile-strength determinations are not plotted, for the reason that the period of the test was so short that no clear-cut differences are apparent early in the test and since the change of tensile strength with time gives no very valuable information.

The treatments tested in the lake were as follows:

281. Untreated twine.
282. 6 per cent cuprous oxide, 20 per cent petroleum asphalt, 74 per cent water gas tar oil.
284. 6 per cent cuprous oxide, 20 per cent coal tar, 74 per cent gas tar oil.
287. 6 per cent cuprous oxide, 20 per cent coal tar, 1/10 per cent mercuric oxide, 74 per cent water gas tar oil.
2811. Two-thirds coal tar, one-third wood tar, applied warm.
2815. 29 per cent copper oleate, 71 per cent kerosene.
2817. 29 per cent copper resinate, 71 per cent water gas tar oil.
2818. 15 per cent copper oleate, 50 per cent coal tar, 35 per cent benzol.
2819. 3/4 per cent mercuric oxide, 6 per cent ferric oxide, 13 per cent coal tar, 7 per cent wood tar, 73 per cent water gas tar oil.
2825. A commercial preparation, said to contain copper salts of naphthenic acids.

The apparent increase in strength of twine when tested immediately after immersion in water is disconcerting at first sight. It has been noticed before and ascribed to errors of sampling, or variations in the strength of the twine whereby occasional lengths of twine stronger than usual would be encountered. Such is not always the case. Larger twine especially shows a tendency to "felt" or more properly to have its fibers become entangled more than usual after immersion in water, with the result that individual fibers do not slip as easily upon each other and that more fibers are broken than is ordinarily the case when the whole twine breaks. The apparent strength is, therefore, higher than before even though the fibers making up the whole may individually be weaker at the time of the test.

A number of Japanese investigators have studied this phenomenon. Terada (1924) has shown that the weakening of twine immersed in water is dependent upon temperatures and is greater in warm water than in cold. This investigator also studied the rate at which twine decomposed and expressed the results in a complicated equation. Tauti (1927) has studied this question further and presents additional experimental data and mathematical analyses. This investigator's paper, and the preceding one, seem to be of most value in that they call attention to the fact that the process of rotting is a complicated one, and that there are facts involved that have not been considered very seriously before. The mathematical treatment apparently is not valid. One of Terada's first assumptions is that there is a constant bacterial environment to serve as a source of weakening influence. This is not true for any great length of time and occurs under conditions where the bacterial population probably will lose its virulence quickly. Tauti assumes in his paper that bacteria increase at a rate equal to $\alpha \eta + \beta$ where α and β are constants. This assumption is true only when the bacteria are in the "logarithmic growth phase," a condition which probably does not prevail in nature and only under special conditions in the laboratory; hence further deductions can not be held valid.

Finely divided solids, such as the pigments used in the net preservative treatments, or mud will keep fibers from sliding upon themselves just as wetting will and hence cause an apparent increase in the strength of test twines at early times in the test period. As a result many preservative treatments appear to increase the strength of the twine during the time of the test—an increase in strength that does not necessarily parallel the strength of the individual fiber—thus making the experimental findings difficult to interpret. For this reason it seems best that observation at this time be limited to examination of the amount of fouling, or at most a microscopic examination of the individual fiber, and that the tensile strength determinations be delayed until deterioration is well advanced. At that time many samples should be taken, and the strengths of the twine carefully determined. Only at this time, when the effect due to rotting is greater than the extraneous effects due to felting, or the presence of solid matter, can one get a good measure of the breakdown of the individual fiber. Experience up to the present time seems to show that early evaluation of net preservative treatments is apt to be misleading.

The upper group of curves in Figure 10 represents mixtures using cuprous oxide as a toxic material, and the lower group represents those treatments using insoluble copper salts of organic acids for this purpose. It will be noted in both cases the copper content decreases with time and approaches a fairly constant value. This is most marked in the case of treatments 2815 and 2818. The curve for treatment 282 is shown on this graph on a reduced scale in order to economize space.

An examination of these curves indicates that in most cases the analytical determinations agree with each other best after the expiration of the first period, in which the rate of decrease in copper concentration is so much greater than it is during the second period, which arbitrarily may be said to date from about the fourth week. The only exception to this, apparently, is the case of treatment 282, which in this series, as well as in others, has shown itself to be most erratic in behavior. This treatment uses petroleum asphalt as a vehicle. This material, therefore, should be dissolved in the water-gas-tar oil and stirred until solution has progressed as far as possible. If a sluge remains the solution should be poured off before the cuprous oxide is added in order to minimize the segregation. Petroleum asphalt need not be used except where coal tar is not easily purchased, but will give results substantially as good as the other tars. Treatment 2825 likewise shows erratic results during the early part of the test. This can be explained on the basis that the treatment was applied in a "spotty" manner. This fact was quite obvious at the time the sample was prepared, but another test specimen was not substituted because of lack of time. As the experiment progressed it became evident that the "spottiness" played a much less important part than it did at first. A visual examination of the lines treated with this preservative showed that the inequality of the treatment had decreased very remarkably after several weeks, and the lines at the end of the test were as uniform in color as those which had preservatives treated with 2815 and 2818. The explanation of these phenomena appears simple. It is that the excess preservative which was on the outside of the twine dissolved or was removed by currents or friction far more rapidly than was the material found within the body of the cord, and that the heavier deposits constituting the "spots" were easily removed and hence disappeared first of all. The material inclosed in the body of the cord is obviously safe from friction and the influence of strong currents and suffers loss only through the process of actual solution.

The process of solution is very slow in general, as is shown by the very gradual downward slope of the curves 2825, 2815, and 2818 after the end of the fourth week. The presence of tar in treatment 2818 apparently hampered this process of solution but very little. After the end of the fourth week treatment 2817 did not behave in the same manner as those previously described. The concentration of toxic material in the twine treated with this preservative does not remain nearly constant after the end of the first period, as do the other treatments but decreases with time more rapidly than do the other toxic materials. This may be explained on the basis that copper resinate is more soluble than the organic copper salts used in the other treatments. This would account for the superior degree of protection offered by this treatment, for as long as there is any copper resinate present it will dissolve slowly, but rapidly enough so that there will exist a toxic atmosphere much more powerful than that which would have been supplied by other materials.

Copper resinate possesses an additional advantage due to the fact that it is possibly more adhesive than copper oleate and not nearly as soft. Hence, it covers the outside fibers of the twine more effectively and resists abrasion longer. Some samples of copper resinate have shown a tendency to become brittle and friable after being applied to the twine, but this effect can be neutralized very effectively by the addition of copper oleate to the treatment.

It seems probable that a mixture of copper resinate and copper oleate will give better satisfaction than either of these materials used alone. The lines treated with copper resinate are "wiry" in feel if the material is applied in large amounts. However a treatment containing 1½ pounds of copper resinate and 1½ pounds of copper oleate per gallon of kerosene, when applied to fine gill thread, leaves it with a softness and flexibility which is apparently near enough the feel of untreated twine to act in the same manner. Copper resinate appears to possess properties which will enable it largely to replace copper oleate for net preservative treatments. First, it is a low-priced copper salt which is sparingly soluble in water but soluble enough to be poisonous to destructive forms of life; secondly, it has the physical properties which enable it to stay on the fiber much longer than copper oleate; and, finally, it is cheaper and more dependable than copper oleate purchased in the open market. Preliminary results from experiments, which have been conducted for the purpose, show that an excess of rosin used in the manufacture of copper resinate does not cause any deleterious effect upon the twine. When an excess of oleic acid is used, however, the twine decreases rapidly in strength.[8]

When one examines carefully the curves representing the changing copper content of twines using cuprous oxide as the active ingredient, one notices that their main characteristic is a rapid decrease from a relatively high copper content to a lower one, which is followed by a very gradual decrease in concentration dating from the fourth week. The explanation of this fact seems to be that the first period marks the time when the coating on the twine covers and projects beyond the outside fibers. This outer coating is not anchored very firmly and is rapidly dislodged. After the greater portion of the loosely adhering toxic material is dislodged, the preservative treatment inclosed within the boundaries of the twine itself has a chance to perform its function of protection. The protection is accomplished partly by solution of the cuprous oxide by the water, but is also accompanied by mechanical dislodgment of some of the toxic material. The latter process is very slow compared to the first "shedding" of active material, since the cuprous oxide particles are entangled between the fibers of the cotton twine and can not fall off or be carried away easily.

The experiments, which we are considering did not extend past the time when most of the toxic material would have been removed from within the twine, and hence it is not possible to study the whole phase of the deterioration of the test material. However, that is not nearly as important as the first phase. From what has been said heretofore, one can safely predict that treatments containing more cuprous oxide than those that have been tried will not be very economical. They, of course, will protect the twine as well as or better than the present treatments, for the time of the preliminary period, which has been extended by reason of the large amount of active ingredients which have been added. However, when this first period of "shedding" is past these newer treatments will be on an equal footing with those using less toxic material. One can say, therefore, that the production of cuprous oxide treatments producing a treated net containing more than about 30 milligrams of copper per lineal foot of No. 24 hard-laid twine can not be very economical unless the shedding which has been encountered with the treatments used in this series of experiments can be decreased very markedly.

PRACTICAL FISHING TESTS

The aid of the fishermen in Mr. Kolbe's crews, and especially the assistance rendered by Capt. Charles Hoskins, made it possible to fish with experimental nets—some treated, some untreated to serve as a basis of comparison—under workaday conditions. This had not been done before and was considered to constitute a most valuable part of

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[8] See Holman and Jarrell, quoted on p. 435, Document No. 998. These investigators found oleic acid alone to have a marked deleterious effect on cotton twine exposed to sunlight. Linseed oil and many other substances also caused the twine to weaken. Rosin was found to exert a detrimental influence, which is contrary to our experience. The results of the two investigations can not be compared too closely, however, for in their experiments the twine was exposed to sunlight, and in ours was immersed in water where only diffused light struck it.

the work of the 1928 season at Erie, since it showed that treated nets do catch fish much the same as untreated "white" ones in spite of the very decided local opinions to the contrary. The prejudice against treating gill nets is so marked that only one man near Erie, Pa., has been found using any preservative treatment. He is Clarence Jackway, of Westfield, N. Y. In the past Mr. Jackway used the copper oleate treatment for gill nets, but abandoned it as unsatisfactory. His opinion in this respect, no doubt, was strengthened by a reluctance to pay the added cost of this relatively expensive treatment. He now uses a solution of coal tar in kerosene, which is applied by pouring the mixture over the dry nets stored in their regular boxes. After a short period of drainage the nets are reeled up to dry in the usual manner. After two days of exposure on the racks they are ready for use.

The tar-kerosene treatment used by Mr. Jackway is prepared by warming 5 parts of kerosene gently with 1 part of coal tar. It might be noted here that in this net treatment, as in others using coal tar, samples having the least "free carbon," or residue insoluble in benzol, are best for preserving nets. The warm mixture of tar and kerosene is allowed to settle until the solution overlying the insoluble residue in the bottom may be poured off ready for use. This treatment is applied to the nets two or three times yearly; it is relatively cheap—the expense being estimated at about 75 cents per net per year. Mr. Jackway reports that nets treated in this manner last two or three times longer than untreated ones, and that the main objection to the treatment is the shrinkage it causes. The fishermen want to use the smallest possible mesh that will pass official inspection as to size of mesh, but can still use treated nets and be safe by ordering a larger sized mesh for those nets which are to be subsequently treated.

The modified tar-kerosene treatment was applied to two alternate nets of a gang of "bull nets" which were used regularly for approximately three months. The remaining two nets of the gang were left untreated so as to serve as a means of comparison. A second gang of "bull nets" was prepared with two nets treated with preservative No. 2850. This treatment originally was designed for trap nets, but produced a treated twine flexible enough so that it was deemed to be suitable for a practical fishing test. The two gangs of nets were placed with others and fished in the usual way. The catch was counted carefully each time the nets were lifted and the results listed. Tables 1 and 2 show the catch for gangs 1 and 2 respectively. Upon examining the results for gang 2, it is seen that the brown nets caught practically as many fish as their untreated neighbors. Upon examining the results for gang 1, it is seen that the black nets did not catch as many fish as the near-by untreated controls nor as many fish as the brown nets of gang 1.

It is difficult to say just what effect the color of nets has upon the actions of fish near by. In this particular case it seems safe to say that both nets are dark enough that the difference between brown and black is not as important in influencing the behavior of the fish as the degree of darkness of the thread, for the reason that the nets are used deep in the water under conditions where there is so little light at best that it would be difficult to distinguish difference in terms of color alone. Everyone has observed how difficult it is to say just what "color" a dark suit really is when beheld in a poor light. The visual powers of fish and their habits in this respect are something concerning which little is known.

It is reported that whitefish and yellow pickerel are best caught in light-colored trap nets, and that ciscoes refuse to enter trap nets at all. This latter effect may be due to the color of the net, to the tendency to flee from the sight of obstructions, or possibly the "smell" of a net.

Sometimes the lake water is not very transparent, hence neither visibility or color perception would be a very large factor in influencing the fish. It may be that the texture of the net was the actual deciding factor. While experience has shown Mr. Jackway's treatment to be good, a modified tar-kerosene treatment was used in these experiments, since previous experiments had shown the preservative action of the tar to be transient—seldom lasting over two months at best. Therefore, 6 pounds of coal tar and 3 pounds of pine tar were mixed with 5 gallons of warm kerosene and allowed to settle. Six pounds of cuprous oxide were added to this solution and the clear solution poured off. Some of the heavier particles of cuprous oxide remained behind; the most finely ground pigment is necessary in this modified treatment, which was designed to have the minimum of heavy or coarse material.

TABLE 5.—*Catches of nets in series 1, July 19 to September 9*

Species of fish	Gang No. 1				Gang No. 2			
	Untreated controls—white net		Treatment No. 2850—black net		Untreated controls—white net		Tar-kerosene treatment—black net	
	Net 1	Net 2	Net 3	Net 4	Net 1	Net 2	Net 3	Net 4
Herring	233	250	224	181	229	229	245	227
Blue pike	32	27	15	21	25	19	24	17
Whitefish	22	16	4	3	15	9	8	7
Burbot	13	12	9	8	13	11	14	16
Perch	8	4	3	2	2	4	4	3
Total	308	309	255	215	284	272	295	270
Average	308		235		278		282	

It seems that the only marked difference between the catch of the various nets is found in the number of whitefish and burbot taken by the nets treated with No. 2850 preservative. This difference for gang 1 seems large enough to be called significant, but gang 2 shows so little difference between nets that when one considers that fish run in schools which often hit nets in irregular groups, it seems reasonable to conclude that treated nets can be safely used for herring fishing in Lake Erie with no danger of decreasing the catch except that fewer whitefish probably will be taken at the same time. Until more extensive future observations give favorable results, whitefish nets should not be preserved with brown or black treatments. This is the safer course to pursue. The data are not sufficient to enable one to make a positive statement, and it appears possible that the difference between dark and light nets might be very small.

In this connection it should be stated that treatment No. 2850 was designed for pound and trap nets and was used on gill nets with the knowledge that the treatment was somewhat dark and heavy for the purpose intended. By accident the proportion of cuprous oxide was nearly doubled, thus rendering the nets still darker. In spite of this the cuprous oxide treatment showed itself to be of value, and it can be confidently expected that treatment with a more suitable modification will be even more satisfactory. No great amount of deterioration took place in the twine for the reason that the total length of time the nets were in the water was only 30 days.[9]

Later tests made under laboratory conditions made it possible to compare the preservative action of this treatment with others. It is hoped that other treatments lighter in color than 2850 will be found for gill nets, but a preservative treatment described below gives results so satisfactory that it must be considered seriously before successors which are untried by practical tests are adopted. A treatment proposed as an alternative to preservative 2850 consists of:

3 pounds cuprous oxide, 98 per cent passing through a 350-mesh sieve.
4 pounds pine tar.
8 pounds coal tar.
10 gallons water-gas-tar oil.

This treatment can be safely recommended as equal in catching power to untreated gill nets. It might possibly catch fewer whitefish than white nets, but a difference in "fishing power" has not been proved yet.

Copper resinate is an effective treatment surpassing copper oleate in preservative action. It is also cheaper and does not allow knots to slip. While no practical fishing tests have been made with copper resinate, it seems that a solution of it containing 1½ to 3 pounds per gallon of kerosene would be equally good as a preservative as copper oleate and have none of its disadvantages.

SUMMARY

In this study the effect of net fouling in Lake Erie has been studied, from which it appears that "red slime" and similar material do not influence the strength of the netting greatly, except in that they harbor destructive bacteria which attack the cotton fibers and cause the net to rot. It has been proved that bacterial attack is the prime cause of the deterioration of nets. Simple methods for preventing bacterial rotting are described.

Since drying, brining, etc., are not always practicable, other preservatives have been tested in Lake Erie. Gill nets treated with two different preservatives have been proved, by practical fishing tests, to catch virtually as many fish as white nets, and to retain their strength longer. These treatments are described on pages 172 and 173.

Nearly all of the treatments used in the test shown in Table 5 are suitable for pound nets. They are all excellent preservatives, though 2811 will decrease in strength rapidly with time, as past experience has shown. Treatment 2811, the usual hot-tar treatment, is sticky; 2818 is not nearly as bad, yet nearly as stiff as tar alone. In physical

[9] At the end of winter storage after this season, the untreated nets had a tensile strength per thread of 2.73 and 2.75 pounds, respectively. The modified tar-kerosene treatment showed a tensile strength of 3.07 pounds, and treatment 2850 tested 2.95 pounds.

appearance 2817 is also stiff and the solvent is not as easy to procure as kerosene, which has been used as a solvent elsewhere with results that were nearly as satisfactory as those obtained on Lake Erie.

Treatment 282, 284, and 287 produce twines which have more flexibility than some of the others and weigh far less than 2811 and 2818. This is a point to be considered in connection with the lifting and washing of nets. They all resemble very closely the cuprous-oxide treatment described above which may be used with the same expectation of success as with these variations.

Treatment 2825 has flexibility but may cause knots to slip, as will 2815; the first is also too expensive to consider seriously. The latter, copper oleate, might well be replaced by copper resinate (2817) in every connection for which it is used for net preservation, since this material is resinous, not slippery like copper oleate. Heavy treatments using cuprous oxide will not prove economical unless it is very important indeed to leave the net in the water as long as possible (without washing and drying) at any one time.

The results of these studies, while performed in fresh water, are applicable to many problems encountered in salt water. In concluding the recommendations, it must be said again that the simplest of treatments and unceasing care will give excellent results; the best treatments when poorly applied to nets which are not washed as frequently as possible, will not prevent deterioration of the twine.

The reader may be interested in the following publications of the Bureau of Fisheries on the subject of net preservation which may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at the prices stated:

Taylor, Harden F.
1920. Preservation of fish nets (with citation of literature). Fisheries Document No. 898. Appendix IV to the Report of the United States Commissioner of Fisheries for 1920, 35 p. Washington. 10 cents.

Taylor, Harden F., and Arthur W. Wells.
1923. Properties and values of certain fish-net preservatives (with bibliography). Fisheries Document No. 947. Appendix I to the Report of the United States Commissioner of Fisheries for 1923, 71 p. Washington. 15 cents.
1925. Further experiments on the preservation of fish nets (with bibliography). Fisheries Document No. 998. Appendix VIII to the Report of the United States Commissioner of Fisheries for 1925, 31 p. Washington. 10 cents.

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EXPERIMENTS IN THE CULTURE OF THE BLACK BASS AND OTHER PONDFISH [1]

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INTRODUCTION

As a result of greater interest in conservation and outdoor activities there is a constantly increasing demand for the so-called warm-water game fishes for stocking purposes. The demand for largemouth and smallmouth black bass has far exceeded the available supply, and since the waters adapted to these fish have a much greater extent than those suitable for trout, it is evident that more efficient methods of propagating bass are urgently needed.

As is well known, the methods employed in the propagation of bass and other pondfishes are very different from those used with trout. In rearing trout we are chiefly concerned with providing a good flow of well-aerated water at the proper temperature and a sufficient amount of suitable food at frequent intervals. In pond culture, however, the fish must be kept under conditions very similar to those to which they are accustomed in nature and the food problem becomes primarily a production problem. In short, trout culture may be likened to the feeding of cattle and sheep in pens or corrals while pond culture is analogous to rearing stock in a pasture or on the open range.

[1] Appendix IX to the Report of the U. S. Commissioner of Fisheries for 1930. B. F. Doc. 1085. Submitted for publication May 6, 1930.

Although it is not practicable to spawn pondfish artificially, the production of fry in large numbers at a reasonable cost presents no great difficulties, and until quite recently little attempt was made to grow bass to a larger size. But, as in the case of trout, it is becoming more and more evident that fry are of relatively little value for stocking purposes and that if we are to maintain good angling in bass waters we must plant larger fish. It is probably true that in some localities, where conditions are exceptionally favorable and there are few predacious fish, fry may give a good account of themselves, but such cases are the exception rather than the rule. If the bass fry are retained in rearing ponds until fall, they will have reached a length of 3 to 4 inches or even more and are consequently well able to fend for themselves.

When we attempt to rear large numbers of bass, or other pondfishes, we are immediately confronted with the problem of providing the fish with an adequate food supply. The most obvious solution is to feed some artificial food such as meat or dry meals, but this is not as simple as it seems. Unlike trout most pondfish do not take readily to an artificial diet, and although brood bass, for instance, may be taught to eat fresh meat it is questionable if this is the best solution of the problem.

A more logical method, and one which we believe will prove more practicable in the end, is to make the ponds self-sustaining so that the fish can subsist on natural food produced in the ponds. It is doubtless advisable in some instances to supplement this with additions from outside sources but, in general, we believe, it will prove more economical to rely mainly on the natural production of the ponds.

The production of fish food in ponds is by no means a simple matter; and if satisfactory results are to be obtained, a thorough knowledge of the principles involved is essential. In pond culture we must deal with a complex series of interacting physical, chemical, and biological factors with relationships to each other, which are often far from clear and are not always easily subjected to investigation. All organisms are dependent on a complex of factors for their existence and development, and if we are to get the best results we must know how to maintain the proper balance of these factors to insure optimum conditions for the propagation and growth, not only of the fish, but of the myriads of organisms which directly or indirectly enter into their food supply. Just as cattle and sheep are dependent on forage crops so the fish in our ponds are dependent on algæ and other aquatic plants for their basic food supply. But unlike cattle and sheep our game fishes, for the most part, do not eat the plants directly. Instead there are series of organisms feeding on each other and forming food chains which start with the algæ and culminate with bass or other game fishes. Obviously then, the problem is not only to produce the proper growth of algæ and other plants but also of the animals which form the intermediate link between the plants and the bass.

Believing that the success of pond culture depends on the proper utilization of these various factors the Bureau of Fisheries in 1926 inaugurated a comprehensive series of investigations in this field at its biological station at Fairport, Iowa. Although these investigations are still in their infancy it is believed that the results already obtained are of sufficient importance to justify their publication at this time.

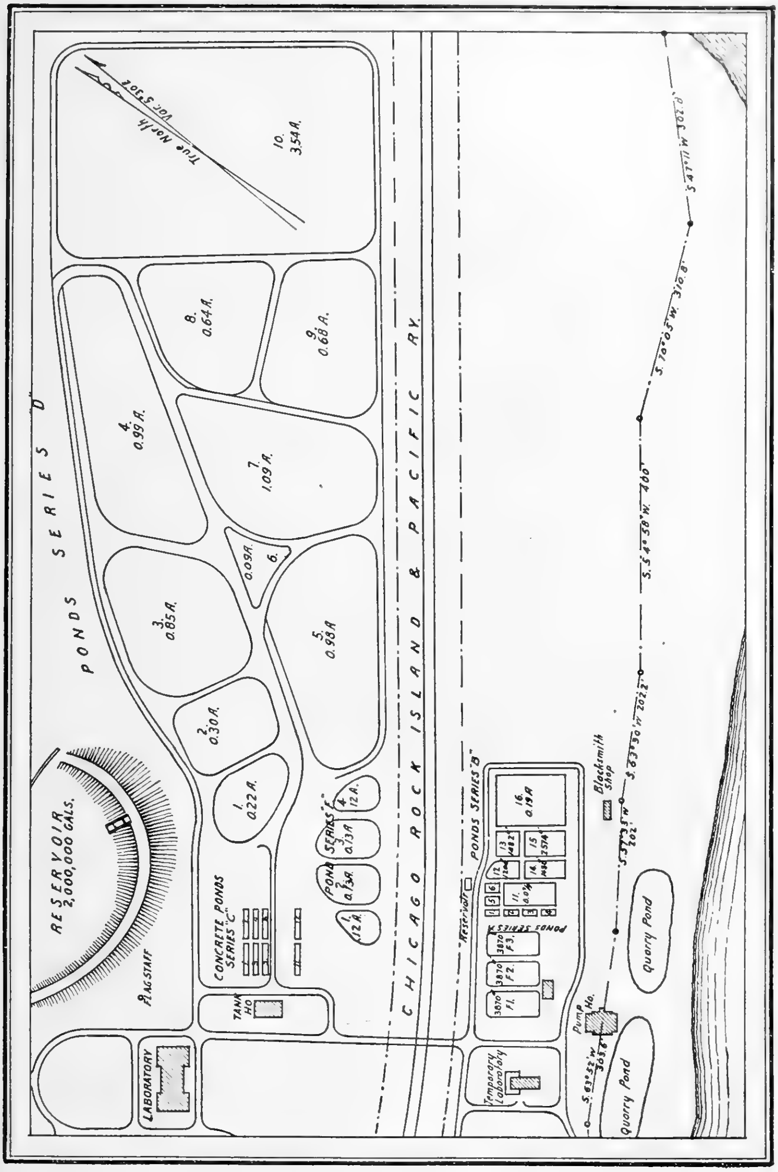

Figure 1.—Chart showing the location of buildings and ponds at the United States Bureau of Fisheries at Fairport, Iowa

The experimental work at the Fairport station has been largely concerned with the largemouth black bass, *Micropterus salmoides*, since local conditions are particularly favorable for this species.

Considerable work, however, has been done with other species of pondfishes including the smallmouth black bass, *Micropterus dolomieu*, the black and white crappies *Pomoxis sparoides* and *P. annularis*, and the bluegill sunfish *Lepomis incisor*.

DESCRIPTION OF PONDS

The location and area of the ponds at the Fairport station are shown in Figure 1. Several of the ponds are so small as to be of little value for experimental purposes and practically all of the experiments described in this paper were conducted in the D, E, and F series of ponds. The D series comprises 10 dirt ponds ranging in size from 0.094 of an acre to 3.54 acres, only 3 of which are less than one-half acre in area. The E series comprises 4 small dirt ponds of nearly equal size. Two of these ponds are slightly larger

FIGURE 2.—Partial view of the D series of ponds at the Fairport station

than the others, having an area of 0.128 acre, while the two smaller are only 0.121 acre in area. The F series includes three small dirt ponds, each having an area of 0.073 acre.

The bottoms of all the ponds slope very gradually from the upper end to the kettle so that the water at one end of the pond may reach a depth of 3.5 to 7 feet—depending on the size of the pond—while at the other end it is only a few inches deep. The ponds are so constructed that they can be completely drained whenever desired, which makes possible a complete recovery of all fish. The water supply is derived from the Mississippi River and is first pumped into the reservoir shown in Figure 1. From the reservoir it is fed to the ponds by gravity through a system of underground pipes. Only enough water is allowed to flow into the ponds to replace that lost by evaporation and seepage.

Practically all of the ponds support a luxuriant growth of aquatic vegetation throughout the summer. The plants are mostly of the submerged type, including both rooted plants and filamentous algæ, and are usually so abundant that they must be removed before the fish can be recovered when the ponds are drained in the fall.

FERTILIZATION OF PONDS

In Europe fertilizers have been used for a number of years to increase fish production in ponds, especially in connection with the rearing of carp (*Cyprinus carpio*) and the Schleihe (*Tinca vulgaris*). Although we are concerned chiefly with other species of fish, it may still be of interest to refer to some of the results obtained by European investigators. Kuhnert (1909) reports that fertilized ponds produce from 18 to 96 kilograms per hectare more carp than ponds that were not fertilized. Experiments conducted during 1909 and 1910 confirmed the results obtained in 1908 (Kuhnert, 1910). Hofer (1915), in a series of papers devoted largely to the discussion of the effects of fertilizer on the chemical constituents of the water, concludes that fertilizing the ponds increases fish production. Czensny (1919) found that as a result of fertilizing the ponds the total 1914 fish production was increased 28.2 per cent, carp production alone was raised 35.7 per cent. Demol (1920) observed an appreciable increase in fish production in 1919 at the Hofer Institute. Wohlgemuth (1922) reporting on fertilizer experiments extending over a period of seven years, 1915–1921, states that in every year the fish production in the fertilized ponds exceeded that in the controls. In 1918 and 1919 the increase in the fertilized ponds exceeded that in the controls by more than 100 per cent. Fisher (1924) found that the use of superphosphate at the Bavarian Pond Fishery Experiment Station increased carp production from 20.8 to 22.9 kilograms per 2,000 m^2 of water area. Walter (1925) on the basis of experiments extending over a period of eight years states that with various phosphate fertilizers the fish production was increased by from 200 to 300 per cent. The same writer (Walter, 1927) reports that in 1926 the increase in fish production resulting from the use of fertilizers amounted to 61 kilograms per hectare in one instance. The idea that fertilizing fishponds is an economically sound practice seems to be fairly generally accepted among fish-culturists in Europe.

While European fish-culturists agree that the addition of fertilizers has a beneficial effect on fish production, there exists among them considerable difference of opinion as to what elements should be supplied through the fertilizer. Their experimental work has centered chiefly around the three elements—potassium, phosphorus, and nitrogen. When all three elements are present in the fertilizer, the fertilization is spoken of as complete; when only one or two elements are added, it is called partial fertilization. The partial fertilization with potassium alone seems to have very little effect on production. This conclusion is almost unanimous. Partial fertilization with phosphorus, however, has produced large increases in production. This is shown by Kuhnert (1909), Czensny (1919), and especially by Fisher (1924) and Walter (1925). Czensny (1919) obtained interesting results when fertilizing with phosphorus and potassium; namely, the fish production was much less when both potassium and phosphorus were used than when the latter was used alone. Czensny ascribes this to the fact that the concentration of potassium had exceeded the upper limit that plants can stand. Most experiments gave better results with complete fertilization—that is, when all three elements, potassium, phosphorus, and nitrogen were added—than with any partial fertilization. Fisher (1924), however, maintains that nothing can be gained from the addition of either nitrogen or potassium, and that phosphorus alone should be added. Walter (1925) claims that in old ponds phosphorus alone is the most suitable fertilizer. There can be no question but that the fertilizer requirements will differ in different localities, depending in large measure on the chemical nature of the pond soil and of the water.

In the work at Fairport, several fertilizer mixtures have been tried. In 1926 a 3 to 1 mixture of sheep manure and bone meal was used. The results obtained were not at all encouraging. One reason for this may be that the phosphorus in the bone meal is very insoluble.

FIGURE 3.—Partial view of the D series of ponds at the Fairport station

Beginning with 1927, superphosphate has been used in place of the bone meal. A 3 to 1 mixture of sheep manure and superphosphate gave very good results during 1927 and 1928. In 1929 the proportions of sheep manure and superphosphate were varied in the direction of more phosphate. It is our opinion, at present, that a 1 to 1 mixture of sheep manure and superphosphate is preferable to a 3 to 1 mixture.

In 1928 and 1929 soybean meal was tried as a pond fertilizer in a few ponds. That this material has possibilities is shown by the results obtained in E 3 during 1929. This pond with an area of 0.128 acre produced 1,457 bass fingerlings, averaging 2½ inches (6.21 centimeters) in length, and 15 selects averaging 5½ inches (13.9 centimeters). The pond was fertilized with soybean meal. That soybean meal may be expected to increase fish production is also evidenced by a series of experiments carried on in the C pond during 1928, which were planned to determine the effect of different fertilizers on plankton production. The effect is here indicated by the average number of crustacea, exclusive of nauplii, based on from 68 to 70 samples taken from each of these ponds. C 1 was fertilized with superphosphate, and the average number of crustacea per liter was 484.41; C 2 was fertilized with soybean meal, and the average number of crustacea per liter was 1,812.21; C 3 fertilized with shrimp bran produced on the average 621.4 crustacea per liter; for C 4, the control pond, the average number of crustacea per liter was 265.72; in C 6, fertilized with sheep manure the average number of crustacea was 660.4. These results show that each one of these fertilizers exerted a beneficial effect, but that the effect was most pronounced in case of the soybean meal.

When using fertilizers the question arises as to whether it is preferable to apply all of the fertilizer at one time or to make smaller applications at relatively short intervals. The latter procedure is probably the more economical. Most ponds have a considerable amount of seepage and if the whole amount of fertilizer is put in at one time there is necessarily some loss of nutrient material. Furthermore, a large dose of fertilizer may produce such a high concentration of some plant nutrient as to be harmful rather than beneficial. Still another objection is the possibility that the presence of large quantities of nitrogenous materials may encourage the activities of denitrifying bacteria and thus cause a loss of valuable nutrients. Finally, if a heavy application of organic fertilizer is made in warm weather, it may so deplete the supply of dissolved oxygen as to endanger the fish life in the pond. For these reasons we have adopted the method of applying fertilizers in small quantities at short intervals rather than resort to infrequent applications of large amounts.

In applying fertilizers the different constituents are weighed and then mixed in the proper proportions. Small amounts of the mixture are distributed over the shallow areas along the margin of the ponds during the spring and early summer at intervals of about 10 days to 2 weeks. The mixture may be applied dry, but if the wind is strong, it is better to moisten the fertilizer before attempting to scatter it over the water.

The amount of fertilizer to be used will depend to a large extent on local conditions. If the pond soil is infertile, more fertilizer will be required than in ponds built in fertile soil. In our work with the 3 to 1 mixture of sheep manure and superphosphate, we have found that 550 pounds per acre for the entire season gave very satisfactory results. During one season we used from 670 to 742 pounds per acre. The results, however, were no better than when 550 pounds per acre were used. In the small ponds as much as 936 pounds per acre were used. In one of these ponds 56 per cent of the bass put in as fry in June were removed as fingerlings in October. This is the highest percentage of survival that we have had at the Fairport station. Very good results have been obtained in the smallmouth black bass pond, when 472 pounds of a 3 to 2 mixture of sheep manure and superphosphate were used. It is possible, however, that the results would have been even better if more fertilizer had been used.

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Soybean meal has given good results when used at the rate of 575 to 700 pounds per acre during the season. Our maximum production of black bass fingerlings was obtained in a pond fertilized with soybean meal at the rate of 700 pounds per acre.

In view of these results it is probable that in most cases from 500 to 1,000 pounds of fertilizer per acre of pond surface will be sufficient. However, if a pond is notably deficient in vegetation or if there is an exceptional amount of seepage, it will doubtless be necessary to use a considerably larger amount of fertilizer if the best results are to be obtained.

FORAGE FISH

The utilization of forage fish in pond culture is a comparatively recent development. Although it is well known that bass and other game fishes subsist largely upon fish in nature most pond culturists have hesitated to adopt this method of providing food for the bass in their ponds. There is a more or less general belief that such a course would only serve to increase cannibalism which is always an important factor when bass are to be reared to any considerable size.

It is obvious that if we are to obtain the maximum production of bass or other game fishes, we must increase the supply of food as much as practicable. Practically all young pondfish at first feed on the plankton crustacea and similar organisms. Many species continue to feed on these organisms and insects throughout their lives but the carnivorous fishes soon begin to prey on their weaker brethren and after a few weeks subsist chiefly on fish. It is true that bass and crappie can subsist largely on insects and crustacea during the first season but the bass, at least, prefer fish and will grow faster on a fish diet than on other foods. No practicable method has yet been developed of greatly increasing the insect life in our ponds, but, fortunately, this is not true of fish and many of the smaller species multiply prodigiously when given the proper conditions. This being the case, there is apparently no reason why we may not utilize such fish to build up a food supply for our game fishes.

As a class, the minnows are preeminently nature's forage fish, but in choosing forage fish for use with bass or other carnivorous pondfishes it is well to bear in mind that not all minnows are equally valuable for this purpose. On the contrary there are certain fundamental requirements which must be met if a fish is to prove satisfactory for forage purposes. Possibly the most important of these is the avoidance of direct competition with game fishes for food. Since all young fish apparently feed at first on animal plankton it is impossible to find a forage fish which will not compete with the young of carnivorous fishes to some extent, but it is important to avoid species which will require the same food as the game fishes for any length of time. This, of course, rules out all predacious fishes no matter what other desirable characters they may possess. If otherwise satisfactory, the most desirable species are undoubtedly those which feed principally upon vegetable material. They utilize a food supply which is not directly available to game fishes and, if readily eaten by them, form a convenient means of converting algæ and vegetable débris into edible fish.

Another desirable feature in a forage fish is a late and protracted spawning season. If a fish spawns earlier than bass or other game fishes, the young are frequently too large to be devoured by the fingerlings, at least until late in the season. The ideal fish in this respect is one which does not spawn until after the game fishes, and which produces a number of broods through the season. There will then be a supply of young fish throughout the summer of the proper size to be readily eaten by the growing fingerlings. Furthermore, a good forage fish should be hardy, prolific, and readily adaptable to pond conditions. It should also have a wide geographical range, since such species are usually more tolerant of varied conditions than those which have a limited distribution.

Barney and Anson (1922) have advocated the use of the orange-spotted sunfish, *Lepomis humilis*, as a forage fish in bass ponds. While this species undoubtedly possesses desirable features for a forage fish, its feeding habits are such as to make it of questionable value for this purpose. According to Barney and Anson this sunfish feeds principally upon small crustacea and insects and practically never eats any vegetable food. Furthermore, it may on occasion prey on small fish which, of course, is a very objectionable feature since there is danger that it might attack the young bass.

The common goldfish has also been used to some extent as a forage fish but in our experiments has not produced satisfactory results. When forage fish are to be propagated in separate ponds and then fed to large fingerlings or to brood fish the goldfish should prove very satisfactory. It is more easily handled than most minnows, is very productive, and is an omnivorous feeder, all of which are desirable features in a fish that is to be used in this way. But as a forage fish for stocking spawning and rearing ponds the goldfish is not recommended. We have not determined definitely the reasons for the poor results with this species under such conditions, but the production of bass in ponds stocked with goldfish has not been equal to that obtained with other forage fish. The early spawning season is an objectionable feature and it is also possible that goldfish may eat bass eggs and fry but we have no conclusive evidence that this is the case.

In our experimental work we have relied chiefly on the blackhead or fathead minnow, *Pimephales promelas*, and the golden shiner or roach, *Notemigonus crysoleucas*, for forage fish with uniformly good results. The selection of these two species for use in our pond experiments was largely owing to the fact that they happen to be the only two minnows possessing the required characteristics which are locally abundant.

The blackhead minnow is a small species with a wide geographical distribution, but is abundant only in certain localities. It is very adaptable to pond culture and will thrive in almost any type of pond if given a fair chance. It is a bottom feeder and is usually considered as belonging to the mud-eating group of minnows. According to Coyle (1930), the blackhead feeds largely on algæ, the animal food being proportionately less abundant than that derived from plants. It apparently feeds quite indiscriminately on a large number of algæ, and the writer concludes that "The algal species found in the alimentary canal of the fathead depend upon the habitat in which the fish is taken; yet the number and size of the gill rakers of the fish determine to a great extent what forms are retained in the alimentary canal."

The blackhead has a long breeding season, spawning fish having been observed at Fairport from the middle of May to early August (Lord, 1927). The eggs are laid in masses on the underside of stones, boards, or other objects, and are closely guarded by the male. The young grow rapidly and mature in one year. This minnow is capable of producing a large number of fish in a limited area, as shown by the production in a small pond in 1928. Pond F 3, with an area of 0.073 acre, was stocked on May 9 with 295 adult blackheads. The pond was drained October 11 and produced 15,691 blackheads having a total weight of 26 pounds. This was at the rate of approximately 215,000 fish or 356 pounds per acre. No food other than fertilizer was added to the pond during the summer.

It is evident that a minow with such possibilities should make a good forage fish, but in our experiments with bass it has proved inferior to the golden shiner. This is probably due chiefly to the small size of the blackhead. Such small, soft fish fall an easy prey to the bass, and even the adults are devoured by the larger fingerlings before the summer is over. The result is that, even though the ponds may be heavily stocked with brood minnows in the spring, the blackheads are practically cleaned out before the ponds are drained in the fall, and the bass, deprived of their favorite food, begin to prey upon each other. There is some evidence that the blackhead may be a desirable forage fish for use with crappie, but we have not yet had an opportunity to try this combination on a sufficiently large scale to warrant definite conclusions.

Since the blackhead is so prolific and feeds to such a large extent on plant material it will no doubt prove to be a valuable fish for growing in ponds by itself. As previously mentioned, the blackhead will thrive in almost any kind of a pond that is rich in vegetation, no matter how small it may be. Every pond station should have several ponds devoted solely to the propagation of forage minnows. Unless this is done there is always danger of losing one's stock of forage fish, since it not infrequently happens that practically every minnow in the bass ponds is devoured before fall. Furthermore, it is essential to have a supply of forage fish on hand for feeding to the brood stock. An occasional meal of minnows will keep these fish in much better condition than if they are fed only artificial food.

As stated above, the golden shiner has proved to be the best forage fish for bass of any that we have tried. It is superior in several respects to other fish which have been used for this purpose, and it is doubtful if there is any other species which combines in an equal degree the desirable qualities of an all-around forage fish. The golden shiner has a very wide geographical distribution and is abundant in suitable localities throughout its range. It is by nature a fish of quiet and stagnant waters and consequently is perfectly at home in the ordinary fishpond. The young feed chiefly on microscopic crustacea and plankton algæ. As they grow older vegetable material, consisting chiefly of algæ, forms a larger percentage of their food, although even adults may feed on crustacea and insects to a considerable extent.

Like the blackhead minnow the golden shiner has a long breeding season, beginning at Fairport in May and continuing until midsummer, and possibly later. The eggs are adhesive and are said to be laid singly on plants but aside from this fact very little is known regarding the spawning habits of the shiner. The only eggs found at Fairport were attached singly to the filaments of mat algæ. Experiments have shown that the fish spawn when 1 year old, but naturally the older fish lay a larger number of eggs than the yearlings.

The productivity of the golden shiner is illustrated by an experiment in pond A 11 which has an area of 0.071 acre. This pond was stocked with 36 adult shiners May 20, 1927. During the following summer 15,104 fish of various sizes were removed from the pond. The pond was drained on October 17 and 26 adults, 602 large fingerlings, and 2,000 small fingerlings removed. This is a total of 17,706 young shiners, which is at the rate of approximately 250,000 per acre.

The following year pond F 2 (area 0.073 acre) was stocked with 34 shiners on May 4. The pond was drained October 13 and yielded 2,339 fingerling shiners and 31 adults. The fingerling production was at the rate of approximately 32,000 per acre. With regard to numbers this is a small yield compared to the previous experiment, but the fish averaged much larger and the actual production of fish flesh was at the rate of approximately 300 pounds to the acre.

LARGEMOUTH BLACK BASS

The natural habits of the largemouth black bass (*Micropterus salmoides*) are such as to make it an ideal pondfish. It is especially well suited to localities where the water is too warm and muddy to provide a suitable environment for smallmouth bass and other game fish that require clearer and cooler water. In addition to its adaptability to warm and sluggish waters, it has other very desirable qualities which have made this fish very popular. For an account of the life history, habits, and distribution of the black basses the reader is referred to the papers of Reighard (1904), Forbes and Richardson (1908), and Adams and Hankinson (1928).

The work at Fairport has differed from most bass cultural work in several very important details: (1) It has aimed at the rearing of bass to fingerling sizes rather than their distribution as fry. The practice of planting bass as fry in streams and lakes where predacious fish are present is of doubtful value, to say the least. (2) Nursery ponds have been employed; that is, ponds to which fry are transferred from the brood ponds and where they are reared away from the adults. (3) An attempt has been made to increase bass production by increasing the natural food supply through the use of fertilizers and of forage minnows. (4) We have adopted the policy of rearing our own brood fish.

The results of this work have shown conclusively that it is practicable to rear bass to fingerling size in small hatchery ponds at a reasonable cost.

In 1928 the Fairport ponds produced a total of 46,392 largemouth fingerlings. The combined area of the ponds devoted to this species was 7.25 acres. This gives an average production of 6,397 fingerlings per acre.

That with the proper care good results may be expected each year is shown by the production in pond D 7 from 1927 to 1929. During this period this pond was used as a nursery pond for the largemouth bass. It was fertilized and stocked with minnows to supply forage for the bass. The average annual production for the 3 years was 8,527 three-inch fingerlings per acre.

BROOD STOCK

When the present investigation was begun, it was the common practice at Fairport, as at other stations, to depend on wild fish for brood stock. These fish were taken from the Mississippi River from time to time as required. This practice has been given up,

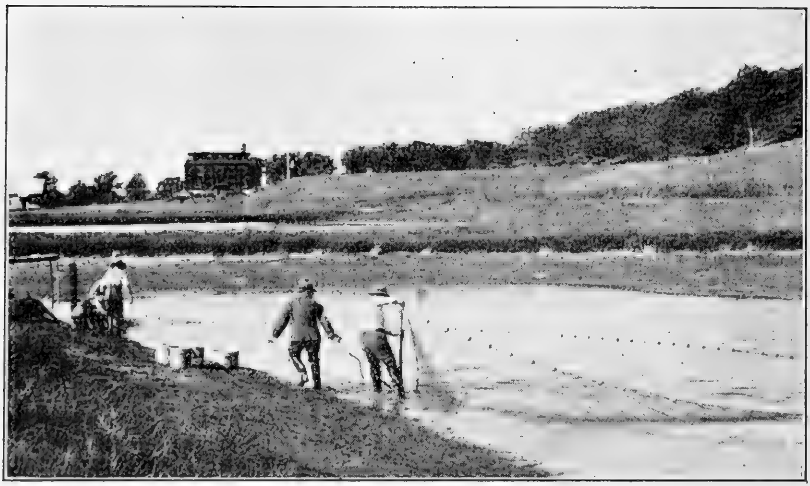

FIGURE 4.—Seining fingerling bass from the ponds at Fairport

and all the fish needed to replenish the brood stocks are now being reared in the station ponds. Each year there are a number of exceptionally large fingerlings ranging from 5 to 8 inches in length. These fish are reared to maturity and kept for breeding purposes. That it is possible to rear brood stock is shown by the fact that at present most of the brood fish used in experimental work have been reared in the station ponds. A number of 2 and 3 year old fish have also been shipped to other localities. The only fish that have not been reared at the station is a lot of 24 adults which were originally wild fish and were at the station when these investigations were first started. The age of these fish is not known, but they have improved each year and last season produced an average of over 6,500 fry to each female.

As a result of rearing our own brood fish, we know definitely the age of each fish and may also practice some selection so that only superior fish are retained for breeding purposes. Another advantage is that it is possible to determine definitely the age at which the bass spawn for the first time, and how long they continue to spawn. As a result of this phase of the work, it has been learned, for instance, that the largemouth bass may spawn at Fairport when 1 year old. This is shown by the results for F 3 in 1927. This pond was stocked in the spring with 27 select yearling bass. Twelve of these were under 6 inches in length. When the pond was drained the following fall, 67 four-inch fingerling bass were found, in addition to the yearlings with which the pond was stocked. It is evident that at least one pair of these bass matured and spawned at the beginning of the second year.

That 2-year-old bass may be expected to spawn is shown by the results for F 3 in 1929. This pond was stocked with 15 two-year-old bass (5 males, 10 females), and produced 12,219 fry. This is an average production of over 1,200 fry per female. These 15 adults when put in the pond weighed only 3 pounds and 1 ounce, or slightly over 3 ounces each. Their small size was due to underfeeding during the previous year. Three-year-old fish have also spawned with a fair degree of success. Age, however, is only one factor in brood fish. Size and weight are probably equally if not more important. We feel that in the past sufficient attention has not been paid to the food of our young brood fish, and consequently, they have not grown as rapidly as they should. Some of the poor results with spawners at Fairport as well as at other stations have probably been due to the fact that the fish had not been fed properly during the previous season.

With reference to the important problem of the number of brood fish which can be expected to produce the best results, our information is still very incomplete. Owing to the small number of ponds at our disposal it will be some time before this question can be settled definitely, but nevertheless some of our results have a bearing on this question.

In 1929 pond D 5 was stocked with 17 females and 7 males (these are the wild fish referred to above). This stocking was at the rate of 24 fish per acre and the ratio of males to females was 1 to 2.4. A total of 101,650 fry were removed in June and in the fall the pond produced 3,808 bass fingerlings averaging 2.9 inches in length. In addition there were 15 "selects" averaging 4.5 inches long. The adults were not weighed in the spring, but in the fall when the pond was drained they averaged 1.84 pounds each. Taking into account the probable percentage of survival, it seems a conservative estimate that a 2-pound female should produce from 6,000 to 7,000 fry. A similar figure for the number of fry per female is obtained when we base our calculations on the results obtained from the same fish in 1928.

These figures are significant, since they show that good results can be obtained when males and females are used in the ratio of 1 to 2.4. This not only makes possible a considerable reduction in the number of brood fish that have to be carried, but it also reduces the number of nests in a pond very materially and also the amount of fighting over females on the part of the males. In most of our spawning ponds, during the last three years, we have used 2 males to 3 females. Apparently 1 male to 2 females would give equally good results.

The use of only 25 adult bass per acre would be too low for a spawning pond since the number of fry would be much less than a pond of this size should produce. On the basis of our experience we would make the following tentative recommendations regarding the number of adults to be used in stocking hatchery ponds:

1. Spawning ponds that are operated primarily for the production of fry should be stocked with about 75 (50 females and 25 males) 2-pound fish or 110 (75 females and 35 males) 1-pound fish per acre. The adults in such heavily stocked ponds should be fed minnows at frequent intervals throughout the summer and fall.

2. Combination spawning and rearing ponds from which no fry are to be removed should be stocked with 15 (10 females and 5 males) 2-pound fish or 25 (17 females and 8 males) 1-pound fish per acre. Such a pond should be stocked with from 500 to 700 large shiners per acre.

NURSERY PONDS

The use of nursery or rearing ponds in the propagation of bass is believed to be advisable since the fry can be utilized to better advantage than by other methods. Where the young bass are reared in the same ponds with the adults there is bound to be some competition for food which may result in cannibalism. The whole tendency in holding young and adults together throughout the summer is to reduce the production of fingerlings. Some pond culturists remove the adults to holding ponds after the spawning season, but we believe it is preferable to remove the fry to nursery ponds and allow the adults to remain where they spawned. The latter method provides complete control over the number of fry allowed in the ponds so that they can be stocked at any desired intensity. Furthermore, it is possible to stock the ponds with young fish of the same age and size which, obviously, will tend to reduce losses from cannibalism.

An additional argument for the use of separate rearing ponds can be found in the fact that knowing how intensely a pond is stocked it is possible in many instances to predict quite accurately the number of fingerlings which will be left in the fall.

The use of nursery ponds seems justified by the results obtained in pond D 7 from 1927 to 1929. During this period the pond was utilized as a nursery pond and the average production for the three seasons was at the rate of 8,527 fingerling bass per acre. Pond D 4, which is but slightly smaller than D 7, was used as a combined rearing and spawning pond and during the same period produced an average of 5,475 fingerlings per acre. In 1926 when both adults and fingerlings were held in D 7 through the summer the production was only 3,779 fingerlings per acre.

At Fairport bass fry are transferred to nursery ponds early in June when they reach a length of about one-half to three-fourths of an inch (15–20 millimeters). They are trapped in the spawning ponds by means of a Hesen fish trap (Hesen, 1929), and are then transferred to the nursery ponds. The number of fry is ascertained by counting several thousand and determining their weight. The bulk of the fry are then weighed and the number calculated. This method is undoubtedly subject to a certain amount of error, but it is the best practical method we have at present.

The optimum number of fry per acre for stocking nursery ponds remains to be determined. This number will, of course, depend on the abundance of food and the size which it is desired to have the fingerling reach in one season. Another very important consideration is the relative cost of production of fry and fingerlings. This cost must determine whether we should aim at a high percentage of survival or at a large number of fingerlings per acre. For instance, the cost of production should determine whether it is better to stock with 10,000 fry to the acre and have 60 per cent survival with 6,000 fingerlings, or to stock with 20,000 fry and get 8,000 fingerlings per acre with a survival rate of 40 per cent. On the basis of our experience we believe that 8,000 fingerlings at the lower rate of survival would be the more economical practice. The following experiments may be of interest in this connection:

In 1926 two small ponds, F 2 and F 3, were stocked with bass 1.5 inches in length at the rate of 1,500 to the acre. These bass made

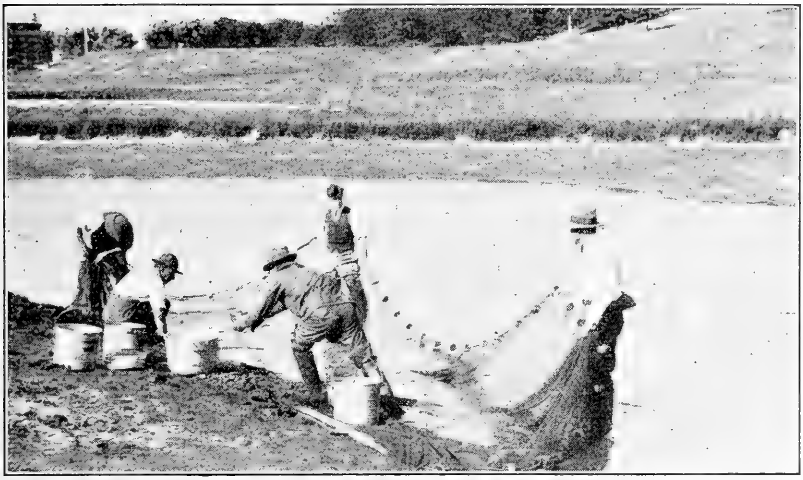

FIGURE 5.—Removing fingerling bass from the ponds at Fairport

a very good growth, but in spite of the fact that they were well advanced before they were placed in the pond, only 67.5 per cent survived in the fall. The fingerling production amounted to 1,024 per acre. The percentage of survival is high as compared with the rest of our results but the production per acre is very low. In the same year some ponds were stocked with small fry at the rate of 26,000 and 36,000 to the acre. The fingerling production amounted to 4,610 and 6,253 per acre, respectively. The percentage of survival in the last two cases was only 17 per cent. In view of our later experiments we do not favor either of these extremes. Our results for D 7 show that from 20,000 to 25,000 fry per acre—if not the optimum number—produce good results. In 1927 this pond was stocked at the rate of 25,000 to the acre; the rate of survival was 33.7 per cent, the fingerling production being 8,018 per acre. In 1928 the same pond was stocked with 22,000 fry to the acre; the rate of survival was 45.8 per cent, and the fingerling production reached 9,963 per acre. In 1929 the pond was again stocked at the rate of 25,000 fry to the acre. This time the rate of survival was only 29.6 per cent and the fingerling production was lowered to 7,581 per acre. This reduced yield is probably attributable to an invasion of crayfish. When this pond was drained in the fall the bottom was literally covered with these crustaceans and over 500 pounds were collected and removed. Crayfish not only compete with the bass for food, but they may also prey on them, to some extent at least. In former years very few crayfish were found in this pond.

The following comparison of results obtained in 1928 at Fairport and the bureau's station at Tupelo, Miss., may be of interest. At Fairport a 3-acre pond was stocked with bass fry at the rate of 20,000 per acre. The fingerling production amounted to 6,487 per acre, the percentage of survival being 33.4 per cent. At the Tupelo station a 3-acre pond was stocked at the rate of 7,666 fry per acre (Leach, 1930, p. 806). This pond produced fingerlings at the rate of 2,510 per acre with a percentage of survival of 30.6 per cent. The difference in the rate of survival is insignificant, but the fact that a 3-acre pond in one case produced 19,462 fingerlings for distribution and in the other only 7,530 deserves some consideration.

In the work at Fairport the number of fry in nursery ponds has varied from 11,000 to 36,000 per acre.[2] Our highest percentage of survival, 55.6 per cent, was obtained in a pond stocked at the rate of 14,000 fry per acre. A survival rate as low as 17.6 per cent has been obtained when stocking at 11,000 per acre. The maximum fingerling production of 11,500 per acre with 46 per cent survival was obtained in a pond stocked with 25,000 fry per acre.

Considering the slight expense involved in the production of fry and the much greater cost of producing fingerlings, we feel that 20,000 to 25,000 fry per acre is probably near the optimum stocking intensity. In recommending this number we have in mind the production of the maximum number of fingerlings per acre without artificial feeding. It is our opinion, based on four years careful observation, that the average rate of survival can not be expected to go much above 40 per cent. In some years it may even fall considerably below this figure. It seems that a certain number of fish disappear between the fry and fingerling stages regardless of the stocking intensity, although naturally the losses are greater when large numbers of fry are used. We have at present under consideration some experiments to determine the time and cause of this heavy mortality.

FORAGE FOR YOUNG BASS

It is generally agreed that the young of black bass at first subsist principally upon entomostraca and a little later, when about an inch long, begin to feed upon the smaller aquatic insects. As they increase in size larger insects appear in the food, and shortly thereafter the young bass begin to prey upon small fish. (Forbes, 1880; Pearse, 1918 and 1921; Turner and Kraatz, 1920; Wickliff, 1920.) After the fingerlings reach a length of about 2 inches they appear to subsist largely upon fish, when these are available. This being the case, if

[2] This is exclusive of the data for F 2 and F 3 for 1926. As these ponds were really stocked with fingerlings the results are not directly comparable.

we can provide the bass fry and small fingerlings with entomostraca and insects for a short time and follow these with a continuous supply of small fish, they should make an uninterrupted growth throughout the summer.

The entomostraca feed largely upon algæ and small fragments of vegetable material, consequently plant growth in the ponds should be stimulated early in the season so as to have sufficient food for the young bass when they appear on the scene. If there is no circulation through the ponds the water will warm up rapidly under the influence of the sun's rays and will soon be swarming with daphnids and other crustacea. Unless the ponds are very heavily stocked with fry they should, if properly fertilized, produce sufficient entomostraca to supply the needs of the young bass until they are able to eat larger organisms. However, if more than 25,000 to 30,000 fry to the acre are to be held in a pond for any length of time, it is advisable to add additional crustacea at frequent intervals. These can be reared in small pools devoted solely to this purpose.

So far we have no practicable method of materially increasing the supply of aquatic insects, but ordinarily these organisms are sufficiently abundant to tide the young bass over the transition stage until they can subsist chiefly on forage fish, with which the ponds should be heavily stocked.

As previously mentioned, three species of fish have been used for forage purposes during the present investigation. Probably the goldfish has been more frequently used as a forage fish for bass than any other species, but in our experiments it has not given satisfactory results. This species is unsuitable for use in nursery ponds, since it spawns before the bass and by the time the young bass begin to feed upon fish many of the goldfish are too large to be eaten. The advisability of introducing goldfish in spawning ponds is also open to question, since they are liable to interfere with the bass nests. Goldfish are, however, very prolific and easily propagated, and since they are eagerly eaten by bass that are large enough to do so they make an ideal fish for feeding to yearlings and also to brood stock during the fall and winter. For this purpose they should be reared in separate ponds and fed to the bass as required.

The blackhead or fathead minnow has also been found unsatisfactory for use in bass ponds, although this species, like the goldfish, may prove to be very desirable for propagating in separate forage ponds. Where fish are to be reared in separate ponds for supplementing the supply of forage fish in spawning and nursery ponds the blackhead is especially recommended.

For stocking spawning and nursery ponds there is probably no forage fish which is superior to the golden shiner. This species has none of the defects of the goldfish and the adults are large enough to escape from even the most precocious bass fingerlings, at least until near the close of the season. Some fish-culturists have accused the shiner of feeding on bass eggs and while we have no definite information to disprove their assertions the results obtained in our spawning ponds clearly indicate that this must happen very rarely, if at all. The shiner is not primarily a bottom feeder, nor is it likely that it would seek the proximity of a bass nest that is being guarded by an adult male.

That the golden shiner is superior to the blackhead as a forage fish in bass ponds is shown by some results obtained in 1928. Pond E 1 was stocked with blackheads for forage and E 4 with shiners. Neither of these ponds was fertilized. The weight in bass produced in E 4 exceeded that in E 1 by 134 per cent. In two fertilized ponds the bass production in the pond stocked with shiners exceeded that in the pond stocked with blackheads by 78 per cent. These results, of course, can not be taken as final, but they strongly indicate that shiners are much superior to blackheads for use with bass.

The number of shiners per acre of pond area has varied considerably during this investigation. At first relatively small numbers were used, but this number has been increased from year to year, so that during the season of 1929 from 600 to 800 shiners per acre were used. Even then the ponds were not overstocked as shown by the small number of shiners recovered when the ponds were drained. E 3, a nursery pond, was stocked in 1929 at the rate of 600 adult shiners to the acre. These shiners spawned very heavily; fry could be seen everywhere in the pond for some time after May 21. Nevertheless when the pond was drained on September 17 no small shiners were found. Incidentally this pond produced bass fingerlings at the rate of 11,500 per acre. In 1928 D 7, a nursery pond, was stocked with 434 adult shiners per acre. No small shiners were taken when the pond was drained on September 28. In 1929 the same pond was stocked at the rate of 800 adult (75 per cent medium and 25 per cent large) shiners per acre. Still no small shiners were left in the fall. D 5, a spawning pond, was stocked with 600 large adult golden shiners. Here likewise no shiner fingerlings were found when the pond was drained. The fact that no small shiners were left by fall shows that these ponds were not overstocked. About 500 to 800 adult shiners, depending on the size, should furnish enough forage in a nursery pond. It would not seem advisable to stock too heavily as the competition for food between the shiner and the bass fry may become severe. The same number of adults (but large fish) should give satisfactory results in a combination spawning and rearing pond. A straight spawning pond that is stocked heavily with brood fish can not be expected to produce enough food to support the bass. Minnows should be reared in separate ponds and then fed to the bass at frequent intervals. For this purpose either goldfish or the golden shiner may be used.

When blackhead minnows are used for forage in bass nursery ponds from 1,000 to 1,500 adults to the acre will be required to give satisfactory results.

USE OF FERTILIZERS IN BASS PONDS

Fertilizers appear to exert a beneficial effect on the productivity of nursery ponds. Wherever our results have been directly comparable in fertilized and in unfertilized ponds there has been an increase in production as a result of fertilization. The most striking difference in this respect was obtained in 1927. During that season E 1 and E 2 were treated alike except that E 2 was fertilized and E 1 was not. The fish produced in E 2 weighed 3.4 times as much as the fish produced in E 1. Another set of two ponds, E 3 and E 4, were likewise treated in identically the same manner except that E 3 was fertilized and E 4 was not. The weight of the fish reared in E 3 was 2.3 times that of those in E 4. In 1928 the differences were not as pronounced, the increase from fertilization ranging from 30 to 70 per cent. The beneficial effect of fertilization is also brought out by a comparison of the results from D 7 and D 10 in 1928. It is quite generally believed by fish-culturists that a new pond is more productive than an old one, which is probably true. Pond D 10 was used for the first time in 1928 whereas D 7 has been in use for many years. Yet D 7 produced 9,963 fingerlings per acre while the production in D 10 was only 6,487 per acre. No fertilizer was used in D 10, but D 7 received 595 pounds of a 3 to 1 mixture of sheep manure and superphosphate. The fingerling production in D 7 exceeded that in D 10 by 3,746 or 53.5 per cent per acre. The average length and weight of the fingerlings from D 10 was 7.02 centimeters and 5.1 grams, respectively; of those from D 7, 6.31 centimeters and 4.5 grams. The quality of the D 10 fingerlings was, therefore, slightly better than that of the D 7 fingerlings. Nevertheless, the total weight of the fingerlings produced per acre in D 7 exceeded that in D 10 by 35.3 per cent.

GROWTH OF LARGEMOUTH BASS

During the present investigations some attention has been given to the growth rate of bass. In all cases the bass fry were measured when placed in nursery ponds and the fingerlings measured when the ponds were drained in the fall. In some instances samples of bass were taken at intervals throughout the summer and measured to determine growth rate at different times during the season. It is not intended to give all of our data at this time as this phase of the work is to be continued. It seems desirable, however, to give sufficient data to show the size bass fingerlings may attain during the short growing season at Fairport. The earliest date on which bass fry have been observed is May 21. The ponds are, as a rule, drained during the last week of September and the first week of October.

In 1927 the bass fry when introduced into the nursery pond, D 7, on June 13 averaged 18.3 millimeters in length and 0.08 gram in weight. When the pond was drained, October 1–11, the bulk of the fingerlings (8,434) averaged 2.9 inches (7.3 centimeters) in length and had an average weight of 5.7 grams. In addition there were 188 fingerlings which were much larger than the others, the largest being 7 inches long. These selects averaged 5.73 inches (14.34 centimeters) in length and had an average weight of 57.52 grams.

In 1928 the fry placed in D 7 on June 7 averaged 14.3 millimeters in length and 0.065 gram in weight. When the pond was drained on September 28 the bulk of the fingerlings (9,930) had an average length of 6.31 centimeters and an average weight of 4.5 grams. In addition there were 33 selects; 16 of these reaching a length of 7 to 8 inches, and one was 11¾ inches long. In D 10 in 1928 the bulk of the fingerlings (19,421) reached an average length of 2.75 inches (7.02 centimeters) and an average weight of 5.1 grams; 41 selects averaged 6.21 inches (15.52 centimeters) and 4 of these were between 8 and 9 inches in length. In D 3 the bass fingerlings in 1928 averaged 3.36 inches (8.4 centimeters) in length and attained an average weight of 9.61 grams by October 3. In 1929 a few fingerlings were raised under conditions that were somewhat superior to the average. These fingerlings (1,290) reached an average length of 4.28 inches (10.71 centimeters) and an average weight of 17.3 grams; 87 fingerlings in the same pond did slightly better and reached an average length of 5.5 inches (13.83 centimeters) and an average weight of 44.9 grams. These data, though incomplete, gives some idea of the rate of growth during the 4-month season at Fairport. This is also shown graphically by means of growth curves in Figure 6.

The variations in the growth rate from time to time are probably due primarily to variations in the food supply. The sharp rise in

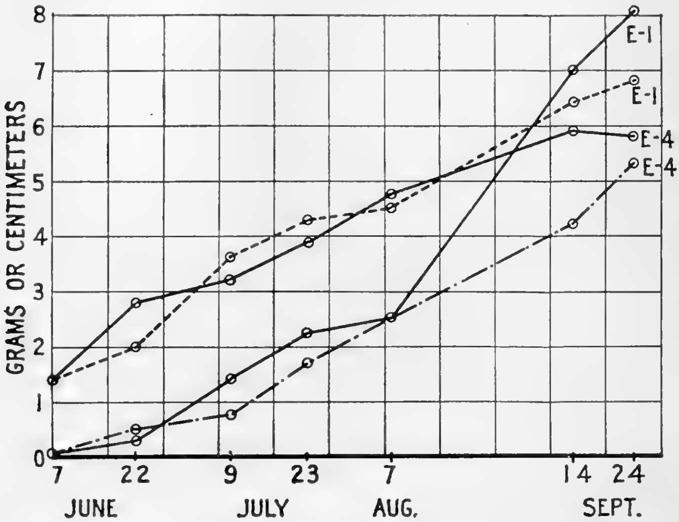

FIGURE 6.—Growth curves of largemouth black bass fingerlings in 1928. The two lower curves represent weights in grams; the two upper, lengths in centimeters

the weight curve for E 1 illustrates what happens when the food supply becomes exhausted and the large bass feed on the smaller. This condition is accompanied by a low percentage of survival.

SMALLMOUTH BLACK BASS

Conditions in the ponds at Fairport are very different from those usually associated with the smallmouth bass (*Micropterus dolomieu*). The warm turbid water and bottoms covered with black mud are so unlike the natural environment of the smallmouth that it was at first thought inadvisable to attempt to propagate this species. However, in the fall of 1927 an opportunity arose to obtain a number of smallmouth bass from the Rock River (Ill.) and it was decided to stock one pond, even though it was doubtful if the venture would prove a success. Accordingly, 11 adults were obtained from the river and wintered in the station ponds without loss. In the following spring 9 more adults were obtained from the same source making a total of 20 fish which were placed in D 8 on May 1. This stocking was at the rate of 31 fish to the acre. At the same time the pond was stocked with adult golden shiners at the rate of 400 to the acre.

The pond was fertilized with a 3 to 1 mixture of sheep manure and superphosphate at the rate of 530 pounds per acre.

The pond was drained, October 5, and a total of 4,393 fingerlings removed, the production being at the rate of 6,800 fingerlings per acre. The great majority of these fingerlings had an average length of slightly over 2 inches (5.35 centimeters), although a few fish had attained a much larger size. Only one adult was lost during the summer. The fact that no shiners were found when the pond was drained indicates that it was understocked with forage fish.

The remaining 19 adult bass were wintered without loss and in the following spring (1929) were placed in D 3 which is somewhat larger than the pond used the previous season. This pond was stocked on April 22 and the fish were sexed as 9 males and 9 females—the sex of one could not be determined from external appearance. The stocking was at the rate of 22.4 fish per acre. For forage the pond was also stocked with 583 golden shiners (700 per acre).

The pond was fertilized with a 2 to 1 mixture of sheep manure and superphosphate at the rate of 472 pounds per acre.

When the pond was drained, September 24 to October 1, 18 adult bass and 6,010 fingerlings were removed. With the exception of 28 "selects" the fingerlings averaged 2.9 inches (7.25 centimeters) in length with an average weight of 19.5 grams. The fingerling production was at the rate of 7,092 per acre. In addition to the bass 730 large shiners were obtained when the pond was drained. The small number of these fish recovered clearly indicates that the pond was not overstocked with forage fish.

The results for 1929 are much better than for 1928. The number of fingerlings per acre is not much greater but they were on the average almost 2 centimeters longer and weighed almost twice as much as in 1928. This improvement in production may be due, among other things, to the larger number of forage fish and the larger proportion of superphosphate in the fertilizer. No attempts have so far been made to rear smallmouth fingerlings in nursery ponds.

THE CRAPPIES

The rearing of crappie (*Pomoxis sparoides* and *P. annularius*) has been a part of the pond cultural program at Fairport since 1925. During the first two years, the two species were reared together, but beginning with 1927 they have been reared separately. The best results with crappie were obtained in 1925, the year before the present investigations were inaugurated. During this year a small pond, B 16, was stocked with these two species at the rate of 67 adults per acre. The yield of fingerlings amounted to 13,000 per acre. The experiment was repeated in the same pond during 1926. This time, however, the pond was stocked at the rate of 217 adults to the acre, and the fingerling production amounted to only 1,826 per acre. Obviously, this pond was greatly overstocked. Another pond, B 14, was stocked at the rate of 555 adults per acre in 1926.

The fingerling production amounted to 467 per acre. It is quite clear from these results that heavy stocking with brood fish is uneconomical. It not only means an additional expense for carrying a larger number of brood fish, but also results in a far smaller production of fingerlings.

WHITE CRAPPIE

The experiments referred to in the last paragraph fail to distinguish between the two species of crappie; and, therefore, there is no means of determining whether each species is equally adaptable to pond culture. The experiments outlined in the following paragraphs show that both species have been reared in ponds with a fair degree of success.

In 1927, the white crappie (*Pomoxis annularius*) was reared together with bluegill sunfish in D 1. The pond was stocked at the rate of 80 adult crappie and 233 bluegill per acre. The fingerling production was at the rate of 8,973 crappie and 44,899 bluegill per acre. Since the bluegill production runs much higher than this when they are reared by themselves, it appears that the crappie fed on the young bluegill and thus held them in check. As far as the bluegill production is concerned, this means fewer but larger fingerlings. In 1928 another attempt was made to rear white crappie, this time using golden shiner as a forage fish. Pond D 9 was used for this experiment, and was stocked at the rate of 44 crappie and 400 golden shiners per acre. When the pond was drained in October, it yielded 6,795 fingerling crappie (8,720 per acre) and 13,788 fingerling shiners (20,130 per acre). The relatively large number of shiners that survived suggests that this minnow is not a suitable forage fish for the white crappie. We have some evidence indicating that the blackhead minnow would be more suitable.

BLACK CRAPPIE

That the black crappie (*P. sparoides*) or calico bass can be propagated successfully in ponds is indicated by the results obtained in 1928. In the spring of that year D 2 was stocked with 14 adult black crappie (46 per acre), 30 adult bluegill (99 per acre), and 20 adult bullheads (66 per acre). This pond produced 3,726 fingerling crappie (12,295 per acre), 2,177 fingerling bluegill (7,184 per acre), and 3,505 fingerling bullheads (11,016 per acre). The crappie production compared favorably with that for 1925, when the two species were raised together.

Our great difficulty in propagating crappie is that the sexes can not readily be distinguished. In the case of the bass, immediately before the spawning season, one can tell with a fair degree of accuracy whether a given individual is a male or a female, but with crappie this is not possible. Another difficulty lies in the fact that the crappie is very sensitive to handling. This results in heavy losses of brood fish during the summer and necessitates a new stock practically every year. These difficulties, we believe, explain some of the poor results that have been obtained with these species in pond cultural work.

BLUEGILL SUNFISH

Everything considered, the bluegill (*Lepomis incisor*) is probably the most desirable of the sunfishes for pond culture. Two or three other species have been propagated in the Southern States with considerable success but for the country at large there is probably no sunfish which possesses as many desirable qualities as the bluegill. It is especially suited to small ponds since it is an omnivorous feeder and will succeed under conditions which would result in failure with bass or crappie.

Although much less attention has been paid to this species in the Fairport experiments than to bass, a few have been propagated each year with considerable success. For the most part they have been reared in ponds which are too small to be suitable for bass.

The largest pond devoted to the propagation of bluegill alone is D 1 having an area of 0.224 of an acre. In the spring of 1926 this pond was stocked with 212 adults and 500 yearlings—a total of 712 fish which is at the rate of approximately 3,180 per acre. At this time it was not realized that the yearlings would spawn as was later found to be the case. In the following September, 25,624 No. 1 fingerlings [3] were removed from the pond which was at the rate of approximately 114,000 to the acre. Including the increase in weight of the yearlings and older fish the total production of fish flesh in this pond during the summer was 188 pounds per acre. This pond was not fertilized.

During the same summer, pond F 1, with an area of 0.073 of an acre was stocked with 300 select yearling bluegills. This was at the rate of about 4,000 per acre. This pond was fertilized with 45 pounds of bone meal and sheep manure and produced 12,000 No. 1 fingerlings (about 144,000 per acre). The actual production of fish flesh was at the rate of 272 pounds to the acre. This figure is, no doubt, more indicative of the possibilities in the production of bluegills than are the results in D 1.

In the following year (1927) D 6 (area 0.087 acre) was stocked with 125 select 2-year-old blugegills. This stocking was at the rate of 1,436 fish per acre. This pond was drained on October 19, the production of fingerlings being at the rate of approximately 200,000 per acre. While this is a satisfactory yield as far as numbers are concerned the fish were smaller than usual, and were evidently too numerous for the amount of food produced in the pond which was not fertilized.

Since it was very evident that in previous years the bluegill ponds had been heavily overstocked with brood fish it was decided to make a radical reduction in the stocking intensity. Accordingly, on April 24, 1929, pond D 1 was stocked with 30 adults (130 per acre). For some unknown reason there was a high mortality among these fish, 22 dying within a few weeks. These were replaced by 17 inferior fish. Under the circumstances the number of fish which actually spawned in the pond is unknown but it must have been much less than in previous years. Nevertheless, when the pond was drained on October 18, 66,792 fingerling bluegills were removed. This production was

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[3] See Report U. S. Commissioner of Fisheries for 1907, Document 630, p. 7, for standard usage in the classification of young fish according to size.

at the rate of about 300,000 per acre but most of the fish were much smaller than in previous years. The pond was not fertilized but received a total of 12.5 pounds of a mixture composed of equal parts shrimp meal and white fish meal. This mixture was first cooked and then run through a meat grinder so as to get it into the form of long shreds, but at no time were the fish observed to eat it.

The adjoining pond, D 2, was stocked with 50 adult bluegills (166 per acre) and 12 adult black crappie. This pond was drained on September 24 and produced 41,297 No. 1 bluegills (136,000 per acre) and 410 fingerling crappie. The small number of crappie was probably due to the fact that the brood fish were in very poor condition when placed in the pond in the spring. Like D 1 this pond was not fertilized but received a total of 20.7 pounds of the shrimp meal and whitefish meal mixture at intervals from April 25 to September 9. Neither the bluegills nor the crappie were seen to take any of the food. Although with respect to numbers the production in D 2 was less than one-half that in D 1 the fingerlings in the former pond averaged about twice the size of those in the latter.

The production of fingerlings in D 2 shows clearly that crappie feed on young bluegills to a considerable extent since the stocking intensity with brood fish was about the same in both D 1 and D 2. This is in accord with some of our experiments with crappie, previously described, where it was shown that the bluegill makes a satisfactory forage fish for this species.

The bluegill is also being used successfully at several hatcheries as a forage fish for largemouth bass but our own results have failed to confirm the favorable reports received from other stations. Our experience with this combination has, however, been very limited and future experiments may yield quite different results. Pond D 3 (area 0.846 acre) was stocked with 50 adult bass and 75 adult bluegills. No other forage fish were placed in the pond. All the bass fry hatched in the pond were allowed to remain through the summer along with the brood fish. The pond was drained October 12 and 1,587 fingerling bass and 23,373 fingerling bluegill were removed. Since the pond was heavily overstocked with bass it is possible that better results would have been obtained if some of the fry had been removed.

On account of the favorable results obtained elsewhere, it is planned to conduct further experiments with bluegills in bass ponds. It is not believed, however, that the bluegill will prove as satisfactory a forage fish for bass as the golden shiner. The feeding habits of the bluegill bring it into more direct competition with the bass fingerlings and it is not impossible that the adults may feed on the eggs or small fingerlings.

From the results of these experiments we may conclude that under favorable conditions a pond stocked with bluegills should produce from 150,000 to 200,000 No. 1 fingerlings per acre. There is still some uncertainty regarding the proper number of brood fish but it is very evident that a high stocking intensity does not result in greater production than when smaller numbers of fish are used. It seems probable that it would be advisable to use even smaller numbers of brood fish than we have yet tried in our experiments. Coggeshall (1923) estimates that a single female may lay from 10,000 to 20,000 eggs. If this is true, only a few fish are required to produce as many fry as can be supported by a 1-acre pond. On the other hand the fry appear to suffer a heavy mortality soon after hatching and there is usually considerable loss among the adults early in the season. For these reasons considerably larger numbers of brood fish should be used than is indicated by their egg-laying capacity.

SUMMARY

1. In the spring of 1926 a comprehensive series of investigations in pond culture was inaugurated by the Bureau of Fisheries at its biological station at Fairport, Iowa. The experimental work has been largely concerned with the largemouth black bass but some attention has also been paid to the smallmouth bass, black and white crappie, and bluegill sunfish.

2. The experiments described in this paper were conducted in dirt ponds supplied with water from the Mississippi River. Many of the ponds are quite small and only seven are over one-half acre in area.

3. Several fertilizers have been tried in the ponds with success, the yield of fish in the fertilized ponds having been much greater than that in the unfertilized ponds. The best results have been obtained with mixtures of superphosphate and dry sheep manure and with soybean meal.

4. Forage fish appear to afford the most practicable method of increasing the natural food supply of bass fingerlings in ponds. In practice, the nursery ponds are stocked with brood minnows in the spring. These fish spawn and thus provide a supply of small minnows for the bass fingerlings throughout the season.

5. Everything considered, the golden shiner appears to be the best forage fish for use in bass ponds. The blackhead minnow and goldfish are valuable where minnows are to be raised in separate ponds for feeding to brood stock.

6. For the propagation of largemouth black bass a combination of spawning and nursery ponds has been found to give the best results. The spawning ponds are heavily stocked with brood fish, using about one male to two females. The fry are trapped when they rise from the nests and placed in nursery ponds which have been previously stocked with brood minnows. These ponds are fertilized at frequent intervals throughout the spring and early summer.

7. The highest production of bass so far obtained was at the rate of 11,550 three-inch fingerlings per acre. In several instances yields of 8,000 to 10,000 fingerlings per acre have been obtained.

8. Although conditions in the ponds at Fairport are quite different from those usually thought to be necessary for the propagation of smallmouth bass, very good results have been obtained with this species during the past two years.

9. Both black and white crappie have been propagated successfully, the highest production obtained being at the rate of about 13,000 fingerlings per acre.

10. Although comparatively little attention has been paid to the propagation of bluegill sunfish, the results obtained indicate that under favorable conditions a pond stocked with this species should produce from 150,000 to 200,000 No. 1 fingerlings per acre.

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ALASKA FISHERY AND FUR-SEAL INDUSTRIES IN 1929 [1]

By Ward T. Bower, *Chief, Division of Alaska Fisheries*

CONTENTS

[1] Appendix X to the Report of the U. S. Commissioner of Fisheries for 1930. B. F. Doc. 1086. Submitted for publication, May 19, 1930.

INTRODUCTION

The enforcement of the law for the protection of the fisheries in Alaska and the management of the fur-seal industry of the Pribilof Islands constitute the chief activities of the Bureau of Fisheries in Alaska.

In the course of the year a number of supplementary regulations were issued for the better protection of the fishery resources. These included an extension of the Yukon-Kuskokwim area and the promulgation of herring regulations therein. Near the end of the year the fishery regulations were completely revised for the season of 1930, a noteworthy feature being further restrictions on the use of traps.

As in previous years Commissioner O'Malley spent a number of weeks in Alaska during the height of the fishing season, thereby making possible prompt changes in the regulations whenever the conservation requirements made such action desirable. He also visited the Pribilof Islands in the commercial sealing season.

In the fisheries patrol work 14 power vessels belonging to the bureau were utilized, and in addition 10 privately owned boats were chartered for short periods. Through the courtesy of the Bureau of Public Roads one of its boats was also used for a brief period. A feature connected with the patrol was the utilization of aircraft for the first time. While the air patrol was limited to the use of a seaplane in southeastern Alaska and was largely experimental in character, it would seem that aircraft will have a definite place in patrol work in the future.

The work of improving salmon streams was continued and the operations were very materially helped by a fund of $40,000 appropriated by the Alaska Legislature, which was made available for use in connection with the bureau's activities.

In 1929, 20 weirs were maintained at important salmon streams in Alaska in order to ascertain the number of salmon ascending to the spawning grounds. Their operation affords a means of establishing the ratio of escape to catch, and of determining the size of spawning colony necessary to prevent depletion of the run. Extensive observations were made of the condition of the salmon spawning grounds throughout a large part of the Territory. Scientific investigations of salmon, herring, and other aquatic resources were continued.

Sealing operations on the Pribilof Islands in 1929 resulted in the take of 40,068 fur-seal skins—the largest number for any year since 1889. A computation as of August 10, 1929, showed a total of 971,527 animals in the herd, an increase of 100,014 over the figures for the preceding year. The care of the fox herds on both St. Paul and St. George Islands was incidental to sealing activities. In the season of 1929–30, 745 blue and 32 white fox pelts were taken.

Construction work at the islands included the erection of houses for natives and a number of buildings for the general purposes of the sealing industry. Further progress was made in the extension of improved roads.

A contract was entered into for the construction of a new power vessel, the *Penguin*, to replace the *Eider* as tender for the Pribilof Islands, and the vessel was nearing completion at the end of the year.

For the protection of fur seals the United States Coast Guard maintained a general patrol of waters of the North Pacific Ocean and Bering Sea frequented by the Pribilof Islands herd. In addition, local patrols were maintained off the coasts of Washington and southeastern Alaska by vessels of the Bureau of Fisheries.

The United States Navy Department afforded valuable assistance by detailing the U. S. S. *Sirius* to transport the annual shipment of general supplies from Seattle to the Pribilof Islands.

Two public auction sales of fur-seal skins were held during the year by the department's selling agents at St. Louis. At one of these fox skins were sold also.

Acknowledgment is made of the assistance rendered by members of the bureau's staff in the compilation and preparation of this document.

VISIT OF THE COMMISSIONER OF FISHERIES TO ALASKA

The Commissioner of Fisheries was in Alaska for approximately two months during the salmon-fishing season to observe the bureau's activities in all districts in respect to the administration of the fishery laws and regulations and to confer with officials and others interested in the fishery industry. A trip was made also to the Pribilof Islands to note sealing operations conducted there.

Commissioner O'Malley sailed from Seattle aboard the *Brant* on June 30 for southeast Alaska, where but a brief time was spent before proceeding westward. Seward was reached on July 9 and departure was made that evening on the *Teal* for Iliamna Bay, whence the journey was continued across the portage to Iliamna Lake and then by boat to Bristol Bay. Through the courtesy of the United States Coast Guard, passage to the Pribilof Islands was furnished by the *Haida*. Departure from the Pribilofs was made on July 21 for Dutch Harbor, where the *Brant* was boarded. Stops were made thereafter at Ikatan, Squaw Harbor, and Karluk. Before returning to southeast Alaska calls were made at several points in the Prince William Sound region. The greater part of August was devoted to the consideration of fishery matters in the southeastern district.

Following his departure from Alaska, Commissioner O'Malley gave attention to various fishery matters on the Pacific coast, and arrived in Washington on September 19.

FISHERY INDUSTRIES

As in corresponding reports for previous years, the Territory of Alaska is here considered in the three coastal geographic sections generally recognized, as follows: (1) Southeast Alaska—embracing all that narrow strip of mainland and the numerous adjacent islands from Portland Canal northwestward to and including Yakutat Bay; (2) central Alaska—the region on the Pacific from Yakutat Bay westward, including Prince William Sound, Cook Inlet, and the southern coast of Alaska Peninsula, to Unimak Pass; and (3) western Alaska—the north shore of the Alaska Peninsula, including the Aleutian Islands westward from Unimak Pass, Bristol Bay, and the Kuskokwim and Yukon Rivers. These divisions are solely for statistical purposes and do not coincide with areas established in departmental regulations.

Detailed reports and statistical tables dealing with the various fishery industries are presented herewith, and there are also given the important features of certain subjects that were the objects of special investigation or inquiry.

ALASKA FISHERIES LEGISLATION

Under date of February 28, 1929, the President approved an act amending the fisheries act of June 26, 1906. This modification broadens the provisions of the former act so that processes of preserving salmon other than by canning or salting within 48 hours after being killed are now recognized. The text of the amendment is as follows:

AN ACT TO amend the Act of Congress of June 26, 1906, entitled "An Act for the protection of the fisheries of Alaska, and for other purposes"

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 7 of the Act of June 26, 1906, entitled "An Act for the protection of the fisheries of Alaska, and for other purposes," is amended so that it will read as follows:

"SEC. 7. It shall be unlawful to preserve for sale as food for human consumption any salmon unless it shall have been canned, salted, iced, frozen, smoked, or dried within forty-eight hours after being killed."

Approved, February 28, 1929.

NEW FISHERY REGULATIONS

The regulations for the protection of the fisheries of Alaska, issued December 18, 1928, were amended by the following regulations issued by the Acting Secretary of Commerce under the dates indicated:

[*January 14, 1929*]

ALASKA PENINSULA AREA

Salmon fishery.—Regulation No. 16 (*i*) is amended to read as follows: Goloi Island, coast for a distance of 4,000 feet northeasterly from the western extremity of the island.

Regulation No. 16 (*n*) is amended to read as follows: Unga Island, east coast from West Head to a point at 55 degrees 11 minutes 30 seconds north latitude, 160 degrees 27 minutes 30 seconds west longitude.

COOK INLET AREA

Salmon fishery.—Regulation No. 13 (*i*) is amended to read as follows: Along the mainland coast on the east side of Cook Inlet from a point at 59 degrees 42 minutes 4 seconds north latitude, 151 degrees 47 minutes 50 seconds west longitude, to a point at 59 degrees 41 minutes 33 seconds north latitude, 151 degrees 46 minutes 30 seconds west longitude.

SOUTHEASTERN ALASKA AREA

YAKUTAT DISTRICT

In Dry Bay the use of any drift gill net more than 60 fathoms in length or more than 35 meshes in depth is prohibited. Except in Dry Bay the use of any drift gill net more than 40 fathoms in length or more than 35 meshes in depth is prohibited. For the purpose of determining depths of drift gill nets measurements will be upon the basis of 5½ inches stretched measure.

NORTH PRINCE OF WALES ISLAND DISTRICT

Salmon fishery.—Regulation No. 13 (*a*) is amended to read as follows: San Juan Bautista Island from a point on the west coast at 55 degrees 25 minutes 45 seconds north latitude southerly and easterly to a point on the south coast at 55 degrees 24 minutes north latitude, 133 degrees 18 minutes 30 seconds west longitude. A part of these waters is in the south Prince of Wales Island district.

SOUTH PRINCE OF WALES ISLAND DISTRICT

Salmon fishery.—Regulation No. 12 (*b*) is amended to read as follows: San Juan Bautista Island from a point on the west coast at 55 degrees 25 minutes 45 seconds north latitude southerly and easterly to a point on the south coast at 55 degrees 24 minutes north latitude, 133 degrees 18 minutes 30 seconds west longitude. A part of these waters is in the north Prince of Wales Island district.

Regulation No. 12 (*n*) is amended to read as follows: Prince of Wales Island, (1) south coast within 600 feet northeasterly from the extremity of land at 54 degrees 43 minutes 5 seconds north latitude, 132 degrees 13 minutes 35 seconds west longitude, and (2) south coast between Brownson Bay and Nichols Bay from a point at 54 degrees 42 minutes 30 seconds north latitude, 132 degrees 10 minutes west longitude, easterly to a point at 54 degrees 41 minutes 22 seconds north latitude, 132 degrees 8 minutes west longitude.

[*January 18, 1929*]

Alaska Peninsula Area

Salmon fishery.—Regulation No. 2 is hereby amended to read as follows: In all other waters of this area, exclusive of the waters along the south side of Alaska Peninsula from Cape Tolstoi to the outer extremity of Kupreanof Point, including the waters of the Shumagin and other adjacent islands, the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock antemeridian of Saturday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 48 hours: *Provided,* That this extension of 12 hours closed period each week shall not be effective after 6 o'clock antemeridian of July 25 in each year.

In the waters along the south side of Alaska Peninsula from Cape Tolstoi to the outer extremity of Kupreanof Point, including the waters of the Shumagin and other adjacent islands, the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock postmeridian of Saturday of each week until 6 o'clock postmeridian of the Wednesday following, making a weekly closed period of 96 hours: *Provided,* That this extension of 60 hours closed period each week shall not be effective after 6 o'clock antemeridian of July 25 in each year.

Regulation No. 16 (*n*) as amended by supplementary regulations (No. 251–15–1) dated January 14, 1929, is further amended to read as follows: Unga Island, east coast from a point at the north side of the entrance to Baralof Bay at 55 degrees 14 minutes 30 seconds north latitude, 160 degrees 32 minutes west longitude in a southerly and easterly direction to a point at 55 degrees 11 minutes 30 seconds north latitude, 160 degrees 27 minutes 30 seconds west longitude.

Regulation No. 16 (*o*) is hereby revoked.

Chignik Area

Salmon fishery.—Regulation No. 1 is amended to read as follows: Commercial fishing for salmon by means of any floating trap or purse seine is prohibited.

The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 75 fathoms hung measure.

No set or anchored gill net shall exceed 25 fathoms in length measured on the cork line.

Set or anchored gill nets shall be operated in substantially a straight line.

The use of motor-propelled gill-net boats in catching salmon is prohibited.

The distance by most direct water measurement from any part of one set or anchored gill net to any part of another set or anchored gill net or to any part of any trap shall not be less than 600 feet.

All set or anchored gill nets shall be removed from the water throughout the weekly closed periods extending from 6 o'clock postmeridian of Saturday of each week to 6 o'clock antemeridian of the Monday following.

No salmon fishing boat shall carry or operate more than one beach seine of any description, and no additional net of any kind shall be carried on such boat. The carrying of any additional seine or net of any kind on a boat towed by any salmon fishing boat is prohibited.

No beach seine shall be less than 50 fathoms or more than 75 fathoms in length measured on the cork line. No beach seine shall be less than 100 meshes or more than 200 meshes in depth. For the purpose of determining depths of seines measurements will be upon the basis of 3½ inches stretched measure between knots.

All commercial fishing for salmon is prohibited in Chignik Lagoon within a line from a point on the mainland at 56 degrees 17 minutes 26 seconds north latitude, 158 degrees 37 minutes 48 seconds west longitude, to a point on the west side of Chignik Island at 56 degrees 17 minutes 15 seconds north latitude, 158 degrees 36 minutes 24 seconds west longitude, thence to a point on the north shore of Chignik Island at 56 degrees 17 minutes 33 seconds north latitude, 158 degrees 34 minutes 54 seconds west longitude, thence to Rocky Point on the east side of Chignik Lagoon at 56 degrees 17 minutes 30 seconds north latitude, 158 degrees 33 minutes 52 seconds west longitude.

Southeastern Alaska Area

SOUTH PRINCE OF WALES ISLAND DISTRICT

Salmon fishery.—Regulation No. 12 (*c*) is amended to read as follows: St. Ignace Island from a point on the south coast at 133 degrees 26 minutes 10 seconds west longitude easterly and northerly to a point on the east coast at 55 degrees 23 minutes 30 seconds north latitude.

Regulation No. 12 (*f*) is amended to read as follows: Prince of Wales Island coast from Point Providence to a point on the coast between Tranquil Point and Point Batan at 133 degrees 13 minutes west longitude.

Southeastern Alaska Area

Herring fishery.—Regulation No. 5 is hereby amended to read as follows: No herring fishing boat shall carry or operate more than one seine of any description and no additional net of any kind shall be carried on such boat. The carrying of any additional seine or net of any kind on a boat towed by any herring fishing boat is prohibited. These prohibitions shall not apply to pound seines used exclusively for impounding herring or to seines used exclusively within waters inclosed by such pound seines.

[*March 23, 1929*]

Kodiak Area

Salmon fishery.—Regulation No. 2 is hereby amended to read as follows: Commercial fishing for salmon by means of any beach seine with mesh smaller than 3 inches stretched measure between knots or with mesh larger than 3½ inches stretched measure between knots is prohibited.

Cook Inlet Area

Salmon fishery.—Regulation No. 13 (*b*) is amended to read as follows: Along the mainland coast on the west side of Cook Inlet from a point at 60 degrees 48 minutes 55 seconds north latitude, 151 degrees 47 minutes 30 seconds west longitude, southeasterly to a point at 60 degrees 44 minutes 10 seconds north latitude, 151 degrees 43 minutes 7 seconds west longitude.

Regulation No. 13 (*g*) is amended to read as follows: Along the mainland coast on the east side of Cook Inlet from the northern extremity of Point Possession southwesterly to a point at 60 degrees 46 minutes 45 seconds north latitude, 151 degrees 9 minutes 30 seconds west longitude, exclusive of 2 statute miles each side of the mouth of Swansons Creek, 2 statute miles each side of Bishop Creek, and 1 statute mile each side of the mouths of all other salmon streams.

Southeastern Alaska Area

NORTH PRINCE OF WALES ISLAND DISTRICT

Salmon fishery.—Regulation No. 13 (*tt*) is hereby amended to read as follows: Grindall Island, off Grindall Point, Prince of Wales Island: Within 3,500 feet northwesterly of the eastern extremity of Approach Point.

Southeastern Alaska Area

Herring fishery.—Commercial fishing for herring, including bait fishing, by means of any beach seine on any herring spawning ground is prohibited.

[*March 29, 1929*]

Alaska Peninsula Area

Salmon fishery.—Regulation No. 16 (*l*) is amended to read as follows: Mainland coast along the west side of Pavlof Bay from 55 degrees 14 minutes 18 seconds north latitude to 55 degrees 20 minutes north latitude, exclusive of any waters in East Bay (Long John Lagoon).

[*April 5, 1929*]

Yukon-Kuskokwim Area

The Yukon-Kuskokwim area is hereby defined to include all territorial coastal and tributary waters of Alaska from Cape Newenham northward to the parallel of 65 degrees north latitude.

Salmon fishery.—1. In the Yukon-Kuskokwim area all commercial fishing for salmon is prohibited at all times: *Provided,* That this prohibition shall not prevent the taking of fish for local food requirements or for use as dog feed.

Herring fishery.—1. Commercial fishing for herring in the waters of Golofnin Bay within a line from the southern extremity of Rocky Point to the southern extremity of Cape Darby is prohibited from January 1 to August 19, both dates inclusive, and from November 1 to December 31, both dates inclusive.

2. Commercial fishing for herring in the waters of Golofnin Bay, within a line from the southern extremity of Rocky Point to the southern extremity of Cape Darby, shall be conducted solely by gill nets.

Southeastern Alaska Area

WESTERN DISTRICT

Salmon fishery.—Regulation No. 3 is amended to read as follows: The distance by most direct water measurement from any part of one trap to any part of another trap shall not be less than 1 statute mile.

Regulation 15 (*h*) is amended to read as follows: Mansfield Peninsula: West coast from a point 500 feet north of False Retreat to the southern extremity of the peninsula at the north side of the entrance to Hawk Inlet but exclusive of Funter Bay.

NORTH PRINCE OF WALES ISLAND DISTRICT

Salmon fishery.—Regulation No. 13 (*tt*) is amended to read as follows: Grindall Island, off Grindall Point, Prince of Wales Island, within 3,500 feet northwesterly of the eastern extremity of Approach Point, and on the south side of Grindall Island within one-eighth statute mile of a point at 55 degrees 26 minutes 20 seconds north latitude, 132 degrees 8 minutes 10 seconds west longitude.

SOUTHERN DISTRICT

Salmon fishery.—Regulation No. 12 (*e*) is amended to read as follows: Annette Island, west coast from a point 1½ statute miles south of Walden Point to Davison Point, including the west shore of Warburton Island.

Regulation No. 12 (*i*) is amended to read as follows: Revillagigedo Island, within one-half statute mile of Escape Point, within 5,000 feet northwesterly of Indian Point, and within 1⅛ statute miles northeasterly from a point north of Point Higgins at 55 degrees 27 minutes 45 seconds north latitude, 131 degrees 49 minutes 58 seconds west longitude.

Regulation No. 12 (*m*) is amended to read as follows: Mainland south of Boca de Quadra, within one-eighth statute mile of a point on Kah Shakes Point at 55 degrees 3 minutes 44 seconds north latitude, 130 degrees 59 minutes 30 seconds west longitude, and from a point south of Kah Shakes Cove at 55 degrees 1 minute 54 seconds north latitude, 131 degrees west longitude, southward to Kirk Point.

All commercial fishing for salmon is prohibited in Raymond Cove, Behm Canal, within a line from the southern extremity of Mike Point northeasterly to a point at 55 degrees 37 minutes 40 seconds north latitude and 131 degrees 51 minutes 56 seconds west longitude.

[*April 26, 1929*]

Alaska Peninsula Area

Salmon fishery.—Regulation No. 16 (*m*) is amended to read as follows: Mainland coast along the east side of Pavlof Bay, (1) within 2,500 feet, measured along the coast, from a point at 55 degrees 35 minutes 12 seconds north latitude; (2) within 2,500 feet, measured along the coast, from a point at 55 degrees 29 minutes 38 seconds north latitude; (3) within 2,500 feet from a point at 55 degrees 27 minutes north latitude; and (4) within 2,500 feet of a point at 55 degrees 23 minutes 42 seconds north latitude.

Cook Inlet Area

Salmon fishery.—Regulation No. 13 (*d*) is amended to read as follows: Along the north coast of Kalgin Island from a point at 60 degrees 30 minutes 32 seconds north latitude, 151 degrees 57 minutes 30 seconds west longitude, easterly to a point at 60 degrees 30 minutes 20 seconds north latitude, 151 degrees 55 minutes west longitude, and from a point at 60 degrees 29 minutes 55 seconds north latitude, 151 degrees 53 minutes 30 seconds west longitude, southeasterly to a point at 60 degrees 29 minutes 40 seconds north latitude, 151 degrees 52 minutes 45 seconds west longitude.

Herring fishery.—The use of purse seines for the capture of herring is prohibited in Kachemak Bay and tributary waters within a line from Nubble Point to Bluff Point.

Southeastern Alaska Area

ICY STRAIT DISTRICT

Salmon fishery.—Regulation No. 14 (*o*) is amended to read as follows: Chichagof Island, northeastern coast, from a point on the south side of Icy Strait at 135 degrees 2 minutes 40 seconds west longitude easterly to a point at 58 degrees 2 minutes 43 seconds north latitude, 134 degrees 58 minutes west longitude.

WESTERN DISTRICT

Salmon fishery.—Regulation No. 15 (*c*) is amended to read as follows: Chichagof Island, eastern coast from a point at 58 degrees 2 minutes 8 seconds north latitude, 134 degrees 56 minutes 26 seconds west longitude, southerly to North Passage Point, exclusive of False Bay.

SOUTHERN DISTRICT

Salmon fishery.—In addition to existing prohibitions commercial fishing for salmon by trolling is prohibited in Behm Canal and its tributaries within a line from Point Sykes to Point Alava, across the eastern entrance of the canal, and a line from Point Higgins to Caamano Point, across the western entrance, from 6 o'clock postmeridian April 30 to 6 o'clock postmeridian June 30.

ALL SOUTHEASTERN ALASKA AREA DISTRICTS

Salmon fishery.—In commercial trolling operations no king salmon shall be caught which when dressed will weigh less than 6 pounds. In the event any such undersized salmon are thus taken, they must be carefully removed from the hook without jerking or other action causing injury and returned to the water alive.

In addition to existing prohibitions commercial fishing for salmon by trolling is prohibited throughout the southeastern Alaska area from 6 o'clock postmeridian August 24 to 6 o'clock postmeridian September 30.

[*May 7, 1929*]

Cook Inlet Area

Salmon fishery.—Regulation No. 13 (*a*) is amended so as to restrict traps along the Moquawkie Indian Reservation to the coast from a point at 61 degrees 2 minutes 15 seconds north latitude, 151 degrees 13 minutes 33 seconds west longitude, southwesterly to a point at 61 degrees 2 minutes 12 seconds north latitude, 151 degrees 15 minutes 12 seconds west longitude.

[*May 25, 1929*]

Cook Inlet Area

Salmon fishery.—Regulation No. 13 (*l*) is amended to read as follows: Along the mainland coast on the east side of Cook Inlet within 1,000 feet of a point at 59 degrees 25 minutes 35 seconds north latitude, 151 degrees 52 minutes west longitude, and from a point at 59 degrees 24 minutes 30 seconds north latitude, 151 degrees 53 minutes 45 seconds west longitude, southerly to a point at 59 degrees 23 minutes 12 seconds north latitude, 151 degrees 54 minutes west longitude.

[*May 29, 1929*]

Southeastern Alaska Area

EASTERN DISTRICT

Salmon fishery.—Regulation No. 14 (*f*) is amended to read as follows: Mainland, Frederick Sound, from a point on the south side of Fanshaw Bay at 133 degrees 32 minutes 30 seconds west longitude to Cape Fanshaw, thence southeasterly to a point at 57 degrees 7 minutes 23 seconds north latitude, 133 degrees 21 minutes west longitude.

[*June 25, 1929*]

Cook Inlet Area

Salmon fishery.—Regulation No. 13 (*n*), which permitted trap fishing within 600 yards of Claim Point, is hereby revoked.

Southeastern Alaska Area

WESTERN DISTRICT

Salmon fishery.—Regulation No. 13 is hereby amended to read as follows: Commercial fishing for salmon is prohibited in Tenakee Inlet and Freshwater Bay within a line from North Passage Point to South Passage Point: *Provided,* That this prohibition shall not apply to trolling from January 1 to 6 o'clock postmeridian August 24.

WESTERN, EASTERN, NORTH PRINCE OF WALES ISLAND, SOUTH PRINCE OF WALES ISLAND, AND SOUTHERN DISTRICTS

Salmon fishery.—In addition to existing prohibitions, commercial fishing for salmon by means of any trap is prohibited from 6 o'clock antemeridian October 1 to 6 o'clock postmeridian October 15.

[*July 5, 1929*]

Southeastern Alaska Area

WESTERN DISTRICT

Salmon fishery.—Supplementary regulation No. 251–15–6, dated April 26, 1929, prohibiting commercial fishing for salmon by trolling throughout the southeastern Alaska area from 6 o'clock postmeridian August 24 to 6 o'clock postmeridian September 30 shall not apply along the west coast of Baranof Island from the south point of entrance to Whale Bay to Cape Ommaney from 6 o'clock postmeridian August 24 to 6 o'clock postmeridian September 5.

EASTERN DISTRICT

Salmon fishery.—Supplementary regulation No. 251–15–6, dated April 26, 1929, prohibiting commercial fishing for salmon by trolling throughout the southeastern Alaska area from 6 o'clock postmeridian August 24 to 6 o'clock postmeridian September 30, shall not apply along the east coast of Baranof Island from Cape Ommaney to the outer extremity of Armstrong Point from 6 o'clock postmeridian August 24 to 6 o'clock postmeridian September 5.

SOUTHERN DISTRICT

Salmon fishery.—Regulation No. 12 (*s*) is hereby amended to read as follows: Kelp Island and East Island east of Kelp Island: Southern coast of Kelp Island between its eastern and western extremities, and the eastern coast of East Island between its northern and southern extremities.

[*July 18, 1929*]

BRISTOL BAY AREA

Salmon fishery.—Regulation No. 9 is amended to read as follows: Commercial fishing for salmon is prohibited in the Nushagak and Kvichak-Naknek districts from 6 o'clock postmeridian July 20 to 6 o'clock antemeridian August 6, and in the Egegik and Ugashik districts from 6 o'clock postmeridian July 23 to 6 o'clock antemeridian August 6.

[*July 24, 1929*]

ALASKA PENINSULA AREA

Salmon fishery.—Regulation No. 16 (*h*) is hereby amended to read as follows: Along the mainland coast, between Belkofsky Bay and Bear Bay, from a point at 55 degrees 6 minutes 6 seconds north latitude, 161 degrees 58 minutes 38 seconds west longitude, to a point at 55 degrees 8 minutes north latitude, 161 degrees 57 minutes 18 seconds west longitude.

[*August 2, 1929*]

PRINCE WILLIAM SOUND AREA

Salmon fishery.—Regulation No. 8 is hereby amended to read as follows: Commercial fishing for salmon is prohibited during the remainder of each calendar year after 6 o'clock antemeridian August 3, except that in the waters along the western coast from the outer point on the north shore of Granite Bay (known as Granite Bay Point) to the light on the south shore of the entrance to Port Nellie Juan commercial fishing for salmon by gill netting is permitted through August 15. All trap leads from shore to entrance of hearts must be removed prior to 6 o'clock antemeridian August 6.

[*August 8, 1929*]

KODIAK AREA

Salmon fishery.—In addition to existing prohibitions commercial fishing for salmon in Karluk waters, extending from Cape Karluk to West Point, is prohibited for the remainder of the calendar year after 6 o'clock postmeridian August 10.

COOK INLET AREA

Salmon fishery.—Regulation No. 1 is amended so as to permit commercial fishing for salmon with beach seines south of the latitude of Anchor Point from 6 o'clock antemeridian August 20 to 6 o'clock postmeridian September 3.

[*August 10, 1929*]

ALEUTIAN ISLANDS AREA

Herring fishery.—All herring pounds must be removed from the water from 6 o'clock postmeridian Saturday of each week until 6 o'clock antemeridian of the Monday following.

The dumping of herring offal in the waters of Unalaska Bay south of 53 degrees 57 minutes north latitude is prohibited.

[*August 17, 1929*]

ALEUTIAN ISLANDS AREA

Herring fishery.—Supplementary regulation of August 10, 1929, requiring the removal of all herring pounds from the water from 6 o'clock postmeridian Saturday of each week until 6 o'clock antemeridian of the Monday following is hereby revoked.

[*August 21, 1929*]

SOUTHEASTERN ALASKA AREA

WESTERN DISTRICT

Salmon fishery.—Commercial fishing for salmon by means of gill nets is permitted in Lynn Canal and contiguous waters between the south end of Kochu Island and the north end of Sullivan Island from 6 o'clock antemeridian September 5 to 6 o'clock postmeridian September 30.

[*August 26, 1929*]

SOUTHEASTERN ALASKA AREA

Salmon fishery.—In addition to existing prohibitions commercial fishing for salmon by trolling is prohibited throughout the southeastern Alaska area during the remainder of the calendar year after 6 o'clock postmeridian September 20: *Provided*, That commercial fishing for salmon by trolling along the east coast of Baranof Island from Cape Ommaney to the outer extremity of Armstrong Point and along the west coast of Baranof Island from Cape Ommaney to the south point of entrance to Whale Bay is permitted through September 30.

[*September 11, 1929*]

SOUTHEASTERN ALASKA AREA

Salmon fishery.—Commercial fishing for salmon by trolling along the east coast of Baranof Island from Cape Ommaney to the outer extremity of Armstrong Point and along the west coast of Baranof Island from Cape Ommaney to the south point of entrance to Whale Bay is permitted during the remainder of the calendar year and in other waters of the southeastern Alaska area during the remainder of the calendar year after 6 o'clock postmeridian September 20.

[*September 13, 1929*]

SOUTHEASTERN ALASKA AREA

YAKUTAT DISTRICT

Salmon fishery.—In addition to existing prohibitions, commercial fishing for salmon, except by trolling, is prohibited in all lagoons and other waters outside or between the mouths of Situk and Ahrnklin Rivers for the remainder of the calendar year after 6 o'clock postmeridian September 20.

Revised regulations covering the fisheries of Alaska were issued by the Secretary of Commerce under date of December 19, 1929, as follows:

By virtue of the authority vested in the Secretary of Commerce, fishing areas are hereby set apart and regulations governing fishing therein are made effective as follows:

I. YUKON-KUSKOKWIM AREA

The Yukon-Kuskokwim area is hereby defined to include all territorial coastal and tributary waters of Alaska from Cape Newenham northward to the parallel of 65 degrees north latitude.

SALMON FISHERY.—In the Yukon-Kuskokwim area all commercial fishing for salmon is prohibited at all times: *Provided*, That this prohibition shall not prevent the taking of fish for local food requirements or for use as dog feed.

HERRING FISHERY.—1. Commercial fishing for herring in the waters of Golofnin Bay within a line from the southern extremity of Rocky Point to the southern extremity of Cape Darby is prohibited from January 1 to August 19, both dates inclusive, and from November 1 to December 31, both dates inclusive.

2. Commercial fishing for herring in the waters of Golofnin Bay, within a line from the southern extremity of Rocky Point to the southern extremity of Cape Darby, shall be conducted solely by gill nets.

II. Bristol Bay Area

The Bristol Bay area is hereby defined to include all territorial coastal and tributary waters of Alaska from Cape Newenham to a point on the coast 3 statute miles south of Cape Menshikof.

Salmon fishery.—1. Commercial fishing for salmon is prohibited except within the following-described districts:

(*a*) Nushagak district: Waters of Nushagak Bay within a line from Point Protection to Etolin Point.

(*b*) Kvichak-Naknek district: Waters of Kvichak Bay within a line from Etolin Point to Middle Bluff Light on the eastern side of Kvichak Bay.

(*c*) Egegik district: Waters between an east and west line 8 statute miles north of South Spit, Egegik Bay, and an east and west line 10 statute miles south of South Spit.

(*d*) Ugashik district: Waters between an east and west line 3 statute miles north of Cape Greig and the southern limit of the area at a point on the coast 3 statute miles south of Cape Menshikof.

2. Commercial fishing for salmon shall be conducted solely by drift gill nets and stake nets. The use of all other forms of fishing gear is prohibited.

3. Each gill net in operation shall be marked by a cluster of floats or corks at the ends, and double floats or corks shall be attached to the cork line at 25-fathom intervals. The clusters of floats or corks at the ends and the double floats or corks at the 25-fathom intervals shall be painted bright red. The clusters at the ends shall also be legibly and plainly marked with the initials of the operator. In addition, metal markers bearing the initials of the operator shall be attached to the ends of each gill-net cork line and at 25-fathom intervals along the cork line.

4. Stake nets shall be operated in substantially a straight line.

5. Commercial fishing for salmon with stake nets shall be limited to beach areas between high and low water marks and shall be confined to the following places:

(*a*) Nushagak district, except along the west side of Nushagak Bay from a point 2 statute miles south of Bradford Point to Coffee Point and along the east side of that bay from a point 2,000 yards southeast of the northern extremity of Ekuk Spit to Etolin Point.

(*b*) Along the beach in front of Koggiung Indian village on Kvichak Bay.

(*c*) Along the beach on the east and west side of Egegik near the Indian village.

(*d*) Along the beach on Ugashik Bay near the Indian village below the Alaska Packers Association cannery.

6. The total aggregate length of stake nets used by any individual shall not exceed 75 fathoms measured on the cork line.

7. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 150 fathoms hung measure.

8. King salmon nets shall have a mesh of at least 8½ inches stretched measure between knots, and red salmon nets shall have a mesh of at least 5½ inches stretched measure between knots as measured when actually in use. No red salmon net shall be over 28 meshes deep.

9. Prior to 6 o'clock antemeridian June 25 in each year commercial fishing for salmon with nets of mesh less than 8½ inches stretched measured between knots is prohibited.

10. Commercial fishing for salmon is prohibited in the period from 6 o'clock antemeridian July 25 to 6 o'clock antemeridian August 6.

11. The trailing of web behind any fishing boat is prohibited above the markers fixing closed waters.

12. The use of motor-propelled fishing boats in catching salmon is prohibited.

13. The use of smelt nets is prohibited in localities where young salmon are migrating.

14. In the waters of Kvichak Bay between the line extending across the bay from the marker on a high point on the east bank of Prosper Creek, about 700 yards above the Koggiung cannery of the Alaska Packers Association, to the marker on the opposite side, the course being about north, 44 degrees west, magnetic, and the line extending at right angles across the bay from a marker at Jensen Creek to a marker on the opposite shore about 1½ miles west of Squaw Creek, the 36-hour weekly closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock postmeridian of Saturday of each week to 6 o'clock antemeridian of the Wednesday following, making a weekly closed period of 84 hours.

15. All commercial fishing for salmon is prohibited as follows:

(*a*) Nushagak Bay: All waters northward of a line from Bradford Point through the southern end of Williams Island to a point on the opposite shore near the old cannery site of the Alaska Packers Association south of Kanulik village except that stake nets limited to beach areas between high and low water marks will be permitted north of 59 degrees north latitude to the old prohibitive markers located at Snag Point.

(*b*) Kvichak Bay: All waters above a line extending at right angles across Kvichak Bay from the marker on a high point on the east bank of Prosper Creek, about 700 yards above the Koggiung cannery of the Alaska Packers Association, to the marker on the opposite side, the course being about north, 44 degrees west, magnetic.

(*c*) Ugashik River and Bay: All waters above a line extending at right angles across said river 500 yards below the mouth of King Salmon River.

STEELHEAD FISHERY.—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

III. ALASKA PENINSULA AREA

The Alaska Peninsula area is hereby defined to include all territorial coastal and tributary waters of the Alaska Peninsula from a point on the coast 3 statute miles south of Cape Menshikof on the Bering Sea shore, extending in a southwesterly direction to Unimak Pass, thence in a northeasterly direction along the Pacific side of the Alaska Peninsula to Castle Cape (Tuliumnit Point). The waters of Unimak, the Sanak, the Shumagin, and all other adjacent islands are included.

SALMON FISHERY.—1. In the waters of Nelson Lagoon, and thence along the coast to Cape Seniavin, including Nelson Lagoon, Herendeen Bay, Port Moller, and the fishing grounds off the Bear, Sandy, and Ocean Rivers, the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the periods from 6 o'clock antemeridian of Wednesday of each week until 6 o'clock antemeridian of the following Thursday, and from 6 o'clock antemeridian of Friday of each week until 6 o'clock antemeridian of the following Saturday, making a weekly closed period in these waters of 84 hours, which shall be effective throughout the entire salmon fishing season of each year.

2. In the waters along the south side of Alaska Peninsula from Cape Tolstoi to the outer extremity of Kupreanof Point including the waters of the Shumagin and other adjacent islands, the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock postmeridian of Saturday of each week until 6 o'clock postmeridian of the Wednesday following, making a weekly closed period of 96 hours: *Provided*, That this extension of 60 hours closed period each week shall not be effective after 6 o'clock antemeridian of July 25 in each year.

3. In all other waters of this area the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock antemeridian of Saturday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 48 hours: *Provided*, That this extension of 12 hours closed period each week shall not be effective after 6 o'clock antemeridian of July 25 in each year.

4. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 200 fathoms hung measure.

5. Stake and anchored gill nets shall be operated in substantially a straight line.

6. The distance by most direct water measurement from any part of one set gill net to any part of another set gill net shall not be less than 1,800 feet.

7. No set or anchored gill net shall exceed 25 fathoms in length measured on the cork line.

8. The use of any beach seine less than 60 fathoms in length or more than 75 fathoms in length is prohibited.

9. The use of floating traps for the capture of salmon is prohibited.

10. In all waters along the shores of the Alaska Peninsula west of the longitude of Cape Aliaksin, and in the waters of Unga Island, the distance by most direct water measurement from any part of one trap to any part of another trap, shall not be less than 1 statute mile.

11. The use of purse seines for the capture of salmon is prohibited, except that (*a*) in the waters of the Shumagin Islands seines not to exceed 100 fathoms in length and 150 meshes in depth may be used, and (*b*) purse seines are permitted in waters open to commercial fishing between Lagoon Point and Cape Seniavin.

12. No boat used in operating any purse seine shall be longer than 50 feet, as shown by official register length: *Provided,* That this shall not apply to such boats operated on the north side of the Alaska Peninsula.

13. In Port Heiden waters the catch of red salmon shall not exceed 50,000 in any calendar year.

14. Commercial fishing for salmon is prohibited prior to 6 o'clock antemeridian June 1 in each calendar year and during the remainder of each calendar year after 6 o'clock postmeridian August 15, except that beach seines and gill nets may be used from September 5 to September 30, both dates inclusive.

15. Commercial fishing for salmon along the mainland shore on the south side of Alaska Peninsula from Kabuch Point easterly to Morgan Point is prohibited prior to July 15 in each year.

16. Commercial fishing for salmon along the mainland shore on the south side of Alaska Peninsula from the outer extremity of Moss Cape to the outer extremity of Kupreanof Point, except in the waters of Orzinski (Orzenoi) Bay, is prohibited prior to July 5 in each year.

17. All commercial fishing for salmon, except by beach seines not exceeding 65 fathoms in length, is prohibited (*a*) in all waters between Cape Tachilni and the southern extremity of Bold Cape and (*b*) in all waters from Cape Tolstoi to the outer extremity of Kupreanof Point. In Orzinski (Orzenoi) Bay the catch of red salmon shall not exceed 20,000 in any calendar year.

18. Commercial fishing for salmon by means of gill nets, including drift nets, and set nets, is prohibited west of 161 degrees west longitude, exclusive of waters along the Bering Sea coast.

19. Commercial fishing for salmon by means of stake nets except along the Bering Sea coast, is prohibited.

20. The use of any trap for the capture of salmon is prohibited, except as follows:

(*a*) Mainland coast, including adjacent islands from Entrance Point to Lagoon Point.

(*b*) Unimak Island: Along the coast on the west and south sides of Ikatan Bay from a point on False Pass (Isanotski Strait) indicated by a marker to a point on Louisiana Cove at 54 degrees 45 minutes 58 seconds north latitude, 163 degrees 8 minutes 52 seconds west longitude.

(*c*) Unimak Island: Along the coast of East Anchor Cove within 2,500 feet, measured along the coast, from a point at 54 degrees 41 minutes 12 seconds north latitude, 163 degrees 3 minutes 36 seconds west longitude.

(*d*) Along the coast on the west side of Morzhovoi Bay from the outer extremity of Boiler Point to a point at 55 degrees 3 minutes 18 seconds north latitude, 163 degrees 12 minutes 44 seconds west longitude.

(*e*) Along the coast on the east side of Morzhovoi Bay within 2,500 feet, measured along the coast, from a point at 55 degrees 0 minutes 38 seconds north latitude, 162 degrees 57 minutes 48 seconds west longitude.

(*f*) Along the coast on the north side of Belkofski Bay for a distance of 5,000 feet westerly of the point at the north side of the entrance to Captain Harbor, exclusive of any waters in Captain Harbor.

(*g*) Along the coast on the south and east side of Kitchen Anchorage, Belkofski Bay, within a distance of 2,500 feet, measured along the coast, from a point at 55 degrees 7 minutes 30 seconds north latitude, 162 degrees 6 minutes 42 seconds west longitude.

(*h*) Along the mainland coast, between Belkofski Bay and Bear Bay, from a point at 55 degrees 6 minutes 6 seconds north latitude, 161 degrees 58 minutes 38 seconds west longitude, to a point at 55 degrees 8 minutes north latitude, 161 degrees 57 minutes 18 seconds west longitude.

(*i*) Goloi Island: Coast for a distance of 4,000 feet northeasterly from the western extremity of the island.

(*j*) Along the coast on the north side of Volcano Bay within 2,500 feet, measured along the coast, from a point at 55 degrees 14 minutes 6 seconds north latitude, 161 degrees 58 minutes 36 seconds west longitude.

(*k*) Along the mainland coast within 2,500 feet, measured along the coast, from a point at 55 degrees 13 minutes 30 seconds north latitude, 161 degrees 52 minutes 36 seconds west longitude.

(*l*) Mainland coast along the west side of Pavlof Bay from 55 degrees 14 minutes 18 seconds north latitude to 55 degrees 20 minutes north latitude, exclusive of any waters in East Bay (Long John Lagoon).

(*m*) Mainland coast along the east side of Pavlof Bay, (1) within 2,500 feet, measured along the coast, from a point at 55 degrees 35 minutes 12 seconds north latitude; (2) within 2,500 feet, measured along the coast, from a point at 55 degrees 29 minutes 38 seconds north latitude; (3) within 2,500 feet from a point at 55 degrees 27 minutes north latitude; and (4) within 2,500 feet of a point at 55 degrees 23 minutes 42 seconds north latitude.

(*n*) Unga Island: East coast from a point at 55 degrees 13 minutes 43 seconds north latitude, 160 degrees 31 minutes west longitude, easterly and southerly to a point at 55 degrees 11 minutes 30 seconds north latitude, 160 degrees 27 minutes 30 seconds west longitude.

21. All commercial fishing for salmon is prohibited, as follows:

(*a*) Within 1 statute mile of the mouths of Bear, Sandy, and Ocean Rivers.

(*b*) Thin Point Lagoon, East Bay (Long John Lagoon), Kinzaroff Lagoon, Mortensen Lagoon, Swanson Lagoon, Big Lagoon, and Middle or Lambsport Lagoon: All waters within the lagoons and their streams and within a distance of 500 yards outside the entrances to the lagoons.

(*c*) Captain Harbor, tributary to Belkofski Bay: All waters within the harbor.

(*d*) Volcano and Bear Bays: All waters west of 161 degrees 59 minutes 30 seconds west longitude.

(*e*) Canoe Bay, tributary to Pavlof Bay.

(*f*) All waters between Kupreanof Point and Cape Ikti.

STEELHEAD FISHERY.—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

HERRING FISHERY.—1. Commercial fishing for herring, except for bait purposes, is prohibited in the period from January 1 to June 30, both dates inclusive, and from December 1 to December 31, both dates inclusive.

2. During the period from June 1 to October 1, both dates inclusive, commercial fishing for herring, including bait fishing, is prohibited in all waters closed throughout the year to salmon fishing.

3. Commercial fishing for herring, except for bait purposes, is prohibited from 6 o'clock postmeridian of Saturday of each week until 6 o'clock antemeridian of the Monday following.

4. Gill nets used in catching herring shall not be of smaller mesh than 3 inches stretched measure.

5. Commercial fishing for herring, including bait fishing, by means of any trap is prohibited.

6. Commercial fishing for herring, including bait fishing, by means of any purse seine more than 1,400 meshes in depth, more than 180 fathoms in length, or of mesh less than 1½ inches stretched measure between knots is prohibited.

7. No one shall place, or cause to be placed, across the entrance of any lagoon or bay any net or other device which will prevent the free passage at all times of herring in and out of said lagoon or bay.

CLAM FISHERY.—It is prohibited to take for commercial purposes any razor clam measuring less than 4½ inches in total length of shell. Possession of any razor clam of less than this length will be regarded as prima facie evidence of unlawful taking.

IV. ALEUTIAN ISLANDS AREA

The Aleutian Islands area is hereby defined to include all territorial coastal and tributary waters of the Aleutian Islands westward of and including Unimak Pass.

SALMON FISHERY.—1. The total aggregate length of gill nets on any salmon fishing boat or in use by such boat shall not exceed 200 fathoms hung measure.

2. Stake and anchored gill nets shall be operated in substantially a straight line.

3. Commercial fishing for salmon is prohibited during the period from 6 o'clock postmeridian August 20 to 6 o'clock postmeridian October 1 in each year.

4. The use of any trap is prohibited.

5. The use of any purse seine exceeding 100 fathoms in length or 150 meshes in depth is prohibited.

STEELHEAD FISHERY.—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

HERRING FISHERY.—1. Commercial fishing for herring, except for bait purposes, is prohibited in the period from January 1 to June 30, both dates inclusive, and from December 1 to December 31, both dates inclusive.

2. Commercial fishing for herring, except for bait purposes, is prohibited from 6 o'clock postmeridian of Saturday of each week until 6 o'clock antemeridian of the Monday following.

3. Gill nets used in catching herring shall not be of smaller mesh than 3 inches stretched measure.

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4. Commercial fishing for herring, including bait fishing, by means of any trap is prohibited.

5. Commercial fishing for herring, including bait fishing, by means of any purse seine more than 1,400 meshes in depth, more than 180 fathoms in length, or of mesh less than 1½ inches stretched measure between knots is prohibited.

6. No one shall place, or cause to be placed, across the entrance of any lagoon or bay any net or other device which will prevent the free passage at all times of herring in and out of said lagoon or bay.

7. The dumping of herring offal in the waters of Unalaska Bay south of 53 degrees 57 minutes north latitude is prohibited.

V. Chignik Area

The Chignik area is hereby defined to include the territorial coastal and tributary waters of Alaska along the mainland shore from Castle Cape (Tuliumnit Point) to Cape Kunmik. The waters of Chankliut, Sutwik, and all other adjacent islands are included.

Salmon fishery.—1. Commercial fishing for salmon by means of any floating trap or purse seine is prohibited.

2. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 75 fathoms hung measure.

3. No set or anchored gill net shall exceed 25 fathoms in length measured on the cork line.

4. Set or anchored gill nets shall be operated in substantially a straight line.

5. The use of motor-propelled gill-net boats in catching salmon is prohibited.

6. The distance by most direct water measurement from any part of one set or anchored gill net to any part of another set or anchored gill net or to any part of any trap shall not be less than 600 feet.

7. All set or anchored gill nets shall be removed from the water throughout the weekly closed periods extending from 6 o'clock postmeridian of Saturday of each week to 6 o'clock antemeridian of the Monday following.

8. No salmon fishing boat shall carry or operate more than one beach seine of any description, and no additional net of any kind shall be carried on such boat. The carrying of any additional seine or net of any kind on a boat towed by any salmon fishing boat is prohibited.

9. No beach seine shall be less than 50 fathoms or more than 75 fathoms in length measured on the cork line. No beach seine shall be less than 100 meshes or more than 200 meshes in depth. For the purpose of determining depths of seines measurements will be upon the basis of 3½ inches stretched measure between knots.

10. All commercial fishing for salmon is prohibited in Chignik Lagoon within a line from a point on the mainland at 56 degrees 17 minutes 26 seconds north latitude, 158 degrees 37 minutes 48 seconds west longitude, to a point on the west side of Chignik Island at 56 degrees 17 minutes 15 seconds north latitude, 158 degrees 36 minutes 24 seconds west longitude, thence to a point on the north shore of Chignik Island at 56 degrees 17 minutes 33 seconds north latitude, 158 degrees 34 minutes 54 seconds west longitude, thence to Rocky Point on the east side of Chignik Lagoon at 56 degrees 17 minutes 30 seconds north latitude, 158 degrees 33 minutes 52 seconds west longitude.

11. The take of salmon within waters in which the runs are tributary to the Chignik River shall not exceed 50 per cent of the total run as determined at the weir in Chignik River operated by the Bureau of Fisheries.

12. Commercial fishing for salmon is prohibited prior to 6 o'clock antemeridian June 1 and after 6 o'clock postmeridian October 1 in each year.

13. Commercial fishing for salmon is prohibited in the waters surrounding Nakchamik and Chankliut Islands.

14. The use of any trap for the capture of salmon is prohibited except as follows:

(*a*) Along the coast of Chignik Lagoon within 2,500 feet from the outer extremity of Hume Point.

(*b*) Along the coast of Chignik Island within 2,500 feet from a point at 56 degrees 17 minutes 30 seconds north latitude, 158 degrees 35 minutes 38 seconds west longitude.

(*c*) Along the east side of the spit at the entrance to Chignik Lagoon from the southern extremity of the spit to a point at 56 degrees 21 minutes 30 seconds north latitude, 158 degrees 30 minutes west longitude.

(*d*) Along the coast of Chignik Bay from a point at 56 degrees 20 minutes 40 seconds north latitude, 158 degrees 27 minutes 30 seconds west longitude, to a point at 56 degrees 20 minutes 48 seconds north latitude, 158 degrees 26 minutes 18 seconds west longitude, including the sand bar offshore.

(*e*) Along the coast on the east side of Anchorage Bay within 2,500 feet from a point at 56 degrees 19 minutes 17 seconds north latitude, 158 degrees 21 minutes 12 seconds west longitude.

(*f*) Along the east side of the spit on the west side of Lake Bay from the northern extremity of the spit at 56 degrees 18 minutes 53 seconds north latitude to a point at 56 degrees 18 minutes 22 seconds north latitude, 158 degrees 16 minutes 41 seconds west longitude.

(*g*) Along the coast on the west side of Hook Bay within 2,500 feet from a point at 56 degrees 30 minutes 54 seconds north latitude, 158 degrees 9 minutes 12 seconds west longitude.

(*h*) Along the coast on the north side of Cape Kumliun within 2,500 feet from a point at 56 degrees 34 minutes north latitude, 157 degrees 56 minutes 8 seconds west longitude.

(*i*) Along the coast on the east side of Kujulik Bay within 2,500 feet from a point at 56 degrees 39 minutes 44 seconds north latitude, 157 degrees 43 minutes 30 seconds west longitude.

(*j*) Along the coast on the south side of Aniakchak Bay for a distance of 5,000 feet westerly and northerly from a point at 56 degrees 40 minutes 20 seconds north latitude, 157 degrees 28 minutes 36 seconds west longitude (as shown on U. S. Coast and Geodetic Survey chart No. 8710).

(*k*) Along the coast on the west side of Aniakchak Bay beginning at a point on the coast 8,000 feet southeasterly of the mouth of the lagoon and extending southeasterly for a distance of 5,000 feet.

(*l*) Along the coast on the west side of Aniakchak Bay beginning at a point on the coast 500 yards southerly of the mouth of Aniakchak River and extending southerly for a distance of 5,000 feet.

15. The distance by most direct water measurement from any part of one trap to any part of another trap shall not be less than 1 statute mile, except in Chignik Lagoon, where there shall be a distance interval of not less than 10 statute miles laterally between any two traps on the north shore or on the south shore of Chignik Lagoon. Chignik Island shall be considered as a part of the south shore of the lagoon.

Steelhead fishery.—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

Clam fishery.—It is prohibited to take for commercial purposes any razor clam measuring less than 4½ inches in total length of shell. Possession of any razor clam of less than this length will be regarded as prima facie evidence of unlawful taking.

VI. Kodiak Area

The Kodiak area is hereby defined to include the waters of the mainland shore extending from Cape Douglas southwestward to Cape Kunmik and the territorial coastal and tributary waters of Alaska surrounding Kodiak, Afognak, and adjacent islands, including Chirikof Island and the Semidi Islands.

Salmon fishery.—1. The use of purse seines and floating traps for the capture of salmon is prohibited.

2. Commercial fishing for salmon by means of any beach seine with mesh smaller than 3 inches stretched measure between knots or with mesh larger than 3½ inches stretched measure between knots is prohibited.

3. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 200 fathoms hung measure.

4. No set or anchored gill net shall exceed 300 yards in length, and each shall be set in substantially a straight line: *Provided*, That not to exceed 20 yards of each net may be used as a hook. Only one such hook is permitted on a net. There shall be a distance interval of at least 200 yards both endwise and laterally at all times between all set or anchored gill nets operated. No wire net lead or other device that impedes or obstructs the free passage of fish shall be used in connection with the operation of any set or anchored gill net.

5. Commercial fishing for salmon in Alitak Bay and all its branches within a line from Cape Trinity to Cape Alitak prior to 6 o'clock antemeridian June 15 in each year is prohibited.

6. Commercial fishing for salmon after August 15, except from September 1 to September 30, both dates inclusive, in each calendar year in Alitak Bay and all its branches within a line from Cape Trinity to Cape Alitak is prohibited: *Pro-*

vided, That this prohibition shall not apply to traps on the north shore of the entrance to Moser Bay within 1 statute mile outside Bun Point.

7. Commercial fishing for salmon within a line from Cape Trinity to Cape Alitak shall be conducted solely by beach seines and traps.

8. The take of salmon within waters in which the runs are tributary to Olga Bay shall not exceed 50 per cent of the total run as determined at the weirs on tributary waters of Olga Bay operated by the Bureau of Fisheries.

9. Commercial fishing for salmon in Karluk waters, extending from Cape Karluk to West Point, prior to 6 o'clock antemeridian June 1 in each year is prohibited. The take of red salmon in these waters shall not exceed 50 per cent of the total run as determined at the weir in Karluk River operated by the Bureau of Fisheries.

10. Commercial fishing for salmon between Cape Karluk and Cape Uyak except by beach seines, and between Cape Uyak and Uyak post office, except by beach seines and gill nets, is prohibited.

11. Commercial fishing for salmon in all waters of Kizhuyak Bay within a line from Kekur Point to Inner Point is prohibited prior to 6 o'clock antemeridian July 21 in each calendar year.

12. Commercial fishing for salmon in all waters of Ugak Bay within a line from Gull Point to Narrow Cape is prohibited prior to 6 o'clock antemeridian July 21 in each calendar year.

13. All commercial fishing for salmon in the Kodiak area is prohibited after September 30 in each calendar year.

14. The distance by most direct water measurement from any part of one trap to any part of another trap, except in those waters of Alitak Bay in which the runs are tributary to streams where counting weirs are maintained, shall not be less than 1 statute mile.

15. Commercial fishing for salmon by means of any beach seine is prohibited from August 16 to August 31, both dates inclusive, in each calendar year, as follows:

(*a*) In all waters of the mainland shore and adjacent islands from Cape Douglas southward to Cape Kunmik.

(*b*) In all waters of Kodiak Island and adjacent islands northwestward from Cape Chiniak to Inner Point, Kizhuyak Bay.

(*c*) In all waters of Terror and Viekoda Bays south of 57 degrees 54 minutes north latitude.

(*d*) In all waters of Uganik Bay, including Uganik Passage and other tributaries and arms within a line from West Point to Uganik Island passing through the northern extremity of East Point.

(*e*) All waters of Shuyak Island, Afognak Island (exclusive of Malina Beach), Marmot Island, Hog Island, and of all other islands north of 58 degrees north latitude adjacent to those islands; all waters of Whale Island, Deranof Island, and Little Raspberry Island; all waters of other islands between Whale and Raspberry Islands; and all waters of Raspberry Strait.

16. Commercial fishing for salmon by means of any trap or beach seine is prohibited from August 16 to August 31, both dates inclusive, in each calendar year, as follows:

(*a*) In all waters of Uyak Bay and its tributaries and adjoining waters within a line from Uyak Postoffice to Cape Kuliuk.

(*b*) In all waters of Kodiak Island from Cape Chiniak to Cape Kiavak. The waters of Ugak Island, Sitkalidak Island, and of other adjacent islands between those capes are included.

17. The use of any trap for the capture of salmon is prohibited, except as follows:

(*a*) Raspberry Island: Coast west of 153 degrees 14 minutes 30 seconds west longitude.

(*b*) Kodiak Island: Coast from a point near the western entrance to Whale Passage at 152 degrees 54 minutes west longitude to Outlet Cape, exclusive of the coast of Dry Spruce Bay within the line from a point at 57 degrees 56 minutes 30 seconds north latitude, 153 degrees 0 minutes 22 seconds west longitude, to a point at 57 degrees 56 minutes 10 seconds north latitude, 153 degrees 3 minutes 40 seconds west longitude.

(*c*) Uganik Island: East coast from a point at 57 degrees 55 minutes 50 seconds north latitude, 153 degrees 21 minutes 28 seconds west longitude, westerly to a point at 153 degrees 28 minutes 20 seconds west longitude.

(*d*) Uganik Island: West coast from a point at 153 degrees 27 minutes west longitude to a point indicated by marker approximately 3 statute miles southwest of Cape Uganik.

(*e*) Kodiak Island: Along the coast on the west side of Uganik Bay between West Point and Broken Point.

(*f*) Kodiak Island near entrance to Uyak Bay: Along the coast within 5,000 feet easterly of a point at 57 degrees 41 minutes 48 seconds north latitude, 153 degrees 54 minutes 45 seconds west longitude.

(*g*) Kodiak Island near entrance to Uyak Bay: Along the coast within 5,000 feet westerly of a point at 57 degrees 41 minutes 47 seconds north latitude, 153 degrees 50 minutes 20 seconds west longitude.

(*h*) Kodiak Island: Coast from the point on the south side of the entrance to Spiridon Bay (or northeast arm of Uyak Bay) southeastward to a point on the east side of Zachar Bay at 57 degrees 34 minutes 35 seconds north latitude.

(*i*) Kodiak Island: Coast from the southern extremity of the point of land at the north side of the entrance to Larsen Bay northward to a point on the west side of Uyak Bay at 57 degrees 35 minutes 42 seconds north latitude.

(*j*) Kodiak Island: Coast from Gull Point southwestward to the southwest extremity of Right Cape.

(*k*) Kodiak Island: Coast from the outer extremity of Left Cape westward to a point on the south shore of Kiliuda Bay at 153 degrees 1 minute west longitude.

(*l*) Kodiak Island: Coast from a point 1 statute mile westward of Sitkalidak or Old Harbor Narrows southwestward to the headland on the north side of Kiavak Bay, exclusive of waters between headlands of Barling, Three Saints, and Kaiugnak Bays.

(*m*) Kodiak Island: Coast along east side of Alitak Bay within 800 feet from a point at 56 degrees 51 minutes 20 seconds north latitude, 154 degrees west longitude.

(*n*) Kodiak Island: Coast along east side of Alitak Bay within 800 feet from a point at 56 degrees 53 minutes 10 seconds north latitude, 153 degrees 58 minutes 52 seconds west longitude.

(*o*) Kodiak Island: Coast along east side of Alitak Bay within 800 feet from a point at 56 degrees 57 minutes north latitude, 153 degrees 57 minutes 50 seconds west longitude.

(*p*) Kodiak Island: Coast along west side of Alitak Bay within 800 feet from a point at 56 degrees 59 minutes 35 seconds north latitude, 154 degrees 3 minutes 40 seconds west longitude.

(*q*) Kodiak Island: Coast along west side of Alitak Bay within 800 feet from a point at 56 degrees 58 minutes 25 seconds north latitude, 154 degrees 3 minutes 40 seconds west longitude.

(*r*) Kodiak Island: Coast along west side of Alitak Bay within 800 feet from a point at 56 degrees 57 minutes 40 seconds north latitude, 154 degrees 4 minutes 10 seconds west longitude.

(*s*) Kodiak Island: Coast along west side of Alitak Bay, near Bun Point, within 800 feet from a point at 56 degrees 58 minutes 20 seconds north latitude, 154 degrees 5 minutes west longitude.

(*t*) Turn Island, in Alitak Bay: Coast along east side of Turn Island within 1,000 feet from the northern extremity of the island.

(*u*) Afognak Island: From a point on the north side of Raspberry Strait at 58 degrees 8 minutes 45 seconds north latitude, 153 degrees 13 minutes 20 seconds west longitude, north to a point at 58 degrees 9 minutes 30 seconds north latitude, 153 degrees 13 minutes 20 seconds west longitude.

18. All commercial fishing for salmon is prohibited, as follows:

(*a*) Deadman Bay, tributary to Alitak Bay: All waters of Deadman Bay within 1 statute mile of the head of the bay.

(*b*) Olga and Moser Bays: All waters of Olga and Moser Bays and contiguous waters within a line from Bun Point through Turn Island at the entrance of Moser Bay to Akhiok village.

(*c*) Western shore of Kodiak Island: All waters along the western shore of Kodiak Island between Cape Alitak and Cape Karluk.

(*d*) Karluk River: All waters within Karluk River and within 100 yards of its mouth where it breaks through Karluk Spit into Shelikof Strait.

(*e*) Larsen Bay, tributary to Uyak Bay: All waters of Larsen Bay west of 154 degrees west longitude.

(*f*) Uyak Bay: All waters of the bay south of 57 degrees 23 minutes 12 seconds north latitude.

(*g*) Zachar Bay, tributary to Uyak Bay: All waters of Zachar Bay east of 153 degrees 48 minutes west longitude.

(*h*) Spiridon Bay (or northeast arm of Uyak Bay): All waters of Spiridon Bay east of 153 degrees 42 minutes west longitude.

(*i*) East Arm, Uganik Bay, Kodiak Island: All waters within the arm, as designated by markers on Packers Spit and Mink Point.

(*j*) Terror Bay: All waters within the bay south of 57 degrees 44 minutes north latitude.

(*k*) Kiliuda Bay: All waters of the bay west of 153 degrees 1 minute west longitude.

(*l*) Southern coast of Kodiak Island: All waters along the southern coast of Kodiak Island between Cape Kiavak and Cape Trinity and all waters of the adjacent islands between those capes, also all waters of the Trinity Islands.

(*m*) All bays of Afognak Island: All waters of the bays within lines indicated by markers erected for the purpose.

(*n*) Kaflia and Halferty Bays, on north shore of Shelikof Strait: All waters of Kaflia Bay within a line from Cape Ugyak to Cape Gull, and all waters of Halferty Bay, which adjoins Kaflia Bay on the southwest.

STEELHEAD FISHERY.—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

HERRING FISHERY.—1. Commercial fishing for herring, except for bait purposes, is prohibited during the period from January 1 to June 30, both dates inclusive.

2. Commercial fishing for herring, except for bait purposes, is prohibited from November 16 to December 31, both dates inclusive: *Provided*, That this prohibition shall not apply to the use of gill nets.

3. During the period from July 15 to October 1, both dates inclusive, commercial fishing for herring, including bait fishing, is prohibited in all waters closed throughout the year to salmon fishing.

4. Gill nets used in catching herring shall not be of smaller mesh than 2½ inches stretched measure.

5. Commercial fishing for herring, including bait fishing, by means of any trap is prohibited.

6. Commercial fishing for herring, including bait fishing, by means of any purse seine more than 1,400 meshes in depth, more than 180 fathoms in length, or of mesh less than 1½ inches stretched measure between knots is prohibited.

7. No one shall place, or cause to be placed, across the entrance of any lagoon or bay any net or other device which will prevent the free passage at all times of herring in and out of said lagoon or bay.

CLAM FISHERY.—It is prohibited to take for commercial purposes any razor clam measuring less than 4½ inches in total length of shell. Possession of any razor clam of less than this length will be regarded as prima facie evidence of unlawful taking.

VII. COOK INLET AREA

The Cook Inlet area is hereby defined to include Cook Inlet, its tributary waters, and all adjoining waters north of Cape Douglas and west of Point Gore. The Barren Islands are included within this area.

SALMON FISHERY.—1. North of the latitude of Anchor Point commercial fishing for salmon is prohibited prior to 6 o'clock antemeridian June 5 and after 6 o'clock postmeridian August 1 in each year. South of the latitude of Anchor Point commercial fishing for salmon is prohibited prior to 6 o'clock antemeridian June 10 and after 6 o'clock postmeridian August 5 in each year, except that beach seines may be operated south of the latitude of Anchor Point in the period from 6 o'clock antemeridian August 20 to 6 o'clock postmeridian September 3.

2. The 36-hour weekly closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock antemeridian of Saturday of each week to 6 o'clock antemeridian of the Monday following, making a weekly closed period of 48 hours.

3. The use of purse seines and floating traps for the capture of salmon is prohibited.

4. The distance by most direct water measurement from any part of one trap to any part of another trap shall not be less than 2,500 feet.

5. Twenty-five feet of the heart walls next to the pot of each hand trap in Cook Inlet shall be constructed of flexible webbing other than wire.

6. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 200 fathoms hung measure.

7. No set or anchored gill net shall exceed 25 fathoms in length measured on the cork line.

8. Stake and set or anchored gill nets shall be operated in substantially a straight line.

9. The distance by most direct water measurement from any part of one set or anchored gill net to any part of another set or anchored gill net or to any part of any trap shall not be less than 600 feet.

10. All set or anchored gill nets shall be removed from the water throughout the weekly closed periods extending from 6 o'clock antemeridian of Saturday of each week to 6 o'clock antemeridian of the Monday following.

11. No salmon fishing boat shall carry or operate more than one seine of any description, and no additional net of any kind shall be carried on such boat. The carrying of any additional seine or net of any kind on a boat towed by any salmon fishing boat is prohibited.

12. No beach seine shall be less than 125 meshes in depth or less than 90 fathoms in length measured on the cork line. For the purpose of determining the depths of seines measurements will be upon the basis of 3½ inches stretched measure between knots.

13. The use of any trap for the capture of salmon is prohibited, except as follows:

(*a*) Along the mainland coast on the west side of Cook Inlet from a point at 61 degrees 9 minutes 15 seconds north latitude, 151 degrees 3 minutes 30 seconds west longitude, southwesterly to a point at 61 degrees 0 minute 40 seconds north latitude, 151 degrees 24 minutes 40 seconds west longitude, exclusive of 2 statute miles each side of the mouth of Chuit River and 1 statute mile each side of the mouths of all other salmon streams: *Provided*, That traps along the Moquawkie Indian Reservation are restricted to the coast from a point at 61 degrees 2 minutes 15 seconds north latitude, 151 degrees 13 minutes 33 seconds west longitude, southwesterly to a point at 61 degrees 2 minutes 12 seconds north latitude, 151 degrees 15 minutes 12 seconds west longitude.

(*b*) Along the mainland coast on the west side of Cook Inlet from a point at 60 degrees 48 minutes 55 seconds north latitude, 151 degrees 47 minutes 30 seconds west longitude, southeasterly to a point at 60 degrees 44 minutes 10 seconds north latitude, 151 degrees 43 minutes 7 seconds west longitude.

(*c*) Along the mainland coast on the west side of Cook Inlet from a point at 60 degrees 24 minutes 10 seconds north latitude, 152 degrees 16 minutes 15 seconds west longitude, to Harriet Point at 60 degrees 23 minutes 30 seconds north latitude, 152 degrees 14 minutes 22 seconds west longitude.

(*d*) Along the north coast of Kalgin Island from a point at 60 degrees 30 minutes 32 seconds north latitude, 151 degrees 57 minutes 30 seconds west longitude, easterly to a point at 60 degrees 30 minutes 20 seconds north latitude, 151 degrees 55 minutes west longitude, and from a point at 60 degrees 29 minutes 55 seconds north latitude, 151 degrees 53 minutes 30 seconds west longitude, southeasterly to a point at 60 degrees 29 minutes 40 seconds north latitude, 151 degrees 52 minutes 45 seconds west longitude.

(*e*) Along the east coast of Kalgin Island from a point at 60 degrees 26 minutes 42 seconds north latitude, 151 degrees 53 minutes 35 seconds west longitude, southerly to a point at 60 degrees 26 minutes north latitude, 151 degrees 56 minutes west longitude, exclusive of 1 statute mile each side of the mouths of all salmon streams.

(*f*) Along the east coast of Chisik Island between the northern and southern extremities of the island.

(*g*) Along the mainland coast on the east side of Cook Inlet from the northern extremity of Point Possession southwesterly to a point at 60 degrees 58 minutes 22 seconds north latitude, 150 degrees 36 minutes 30 seconds west longitude, exclusive of 1 statute mile each side of the mouths of all salmon streams and exclusive of the coast within 1,000 feet of a point at 61 degrees 2 minutes north latitude, 150 degrees 24 minutes 45 seconds west longitude.

(*h*) Along the mainland coast on the east side of Cook Inlet from a point at 60 degrees 58 minutes north latitude, 150 degrees 37 minutes 40 seconds west longitude, southwesterly to a point at 60 degrees 50 minutes 22 seconds north latitude, 150 degrees 56 minutes 6 seconds west longitude, exclusive of 1 statute mile each side of the mouths of all salmon streams and exclusive of the coast between 60 degrees 57 minutes 45 seconds north latitude and 60 degrees 56 minutes 50 seconds north latitude.

(*i*) Along the mainland coast on the east side of Cook Inlet from a point at 60 degrees 49 minutes 40 seconds north latitude, 150 degrees 58 minutes west longitude, southwesterly to a point at 60 degrees 46 minutes 45 seconds north latitude, 151 degrees 9 minutes 30 seconds west longitude, exclusive of 2 statute miles each side of the mouth of Swanson Creek, 2 statute miles each side of Bishop Creek, and 1 statute mile each side of the mouths of all other salmon streams.

(*j*) Along the mainland coast on the east side of Cook Inlet from a point north of Boulder Point at 60 degrees 46 minutes 18 seconds north latitude, 151 degrees 15 minutes 40 seconds west longitude, southerly to a point 2 statute miles northward from the mouth of Anchor Point River, exclusive of 2½ statute miles each side of the mouth of Kenai River, 2½ statute miles each side of the mouth of Kasilof River, 2 statute miles each side of the mouth of Ninilchik River, 2 statute miles each side of the mouth of Deep Creek, and 1 statute mile each side of the mouths of all other salmon streams and exclusive of the coast within 6,000 feet of a point at 59 degrees 57 minutes 50 seconds north latitude, 151 degrees 44 minutes 17 seconds west longitude.

(*k*) Along the mainland coast on the east side of Cook Inlet from a point at 59 degrees 42 minutes 4 seconds north latitude, 151 degrees 47 minutes 50 seconds west longitude, to a point at 59 degrees 41 minutes 33 seconds north latitude, 151 degrees 46 minutes 30 seconds west longitude.

(*l*) Along the mainland coast on the east side of Cook Inlet from the northern extremity of Nubble Point westerly along the west side of Nubble Point Spit to a point at 59 degrees 28 minutes 30 seconds north latitude, 151 degrees 37 minutes 30 seconds west longitude.

(*m*) Along the mainland coast on the east side of Cook Inlet from a point at 59 degrees 26 minutes 30 seconds north latitude, 151 degrees 46 minutes west longitude, westerly to a point at 59 degrees 26 minutes 40 seconds north latitude, 151 degrees 46 minutes 45 seconds west longitude.

(*n*) Along the mainland coast on the east side of Cook Inlet within 1,000 feet of a point at 59 degrees 25 minutes 35 seconds north latitude, 151 degrees 52 minutes west longitude, and from a point at 59 degrees 24 minutes 30 seconds north latitude, 151 degrees 53 minutes 45 seconds west longitude, southerly to a point at 59 degrees 23 minutes 12 seconds north latitude, 151 degrees 54 minutes west longitude.

(*o*) Along the mainland coast on the east side of Cook Inlet from a point at 59 degrees 21 minutes 28 seconds north latitude, 151 degrees 55 minutes west longitude, southwesterly to a point at 59 degrees 19 minutes 20 seconds north latitude, 151 degrees 58 minutes 30 seconds west longitude, exclusive of 1 statute mile each side of the mouths of all salmon streams.

14. All commercial fishing is prohibited, as follows:

(*a*) Within 2½ statute miles of the mouths of Kasilof and Kenai Rivers, and within 1 statute mile of all other salmon streams.

(*b*) Turnagain Arm and Knik Arm: All waters above a line from Point Possession to the western limit of the closed area around the mouth of the Susitna River.

(*c*) Chinik Inlet, Kamishak Bay: All waters within the inlet.

(*d*) Kachemak Bay: All waters above a line from Indian Island to a point on the opposite shore one-half mile below the mouth of Swift Creek.

Steelhead fishery.—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

Herring fishery.—1. Commercial fishing for herring, except for bait purposes, is prohibited during the period from January 1 to June 30, both dates inclusive, and from November 16 to December 31, both dates inclusive: *Provided,* That this prohibition shall not apply to the use of set and drift gill nets in the period from November 16 to December 31, both dates inclusive.

2. During the period from July 1 to October 1, both dates inclusive, commercial fishing for herring, including bait fishing, is prohibited in all waters closed throughout the year to salmon fishing.

3. Commercial fishing for herring in Halibut Cove, including the waters within a line from the western end of Ismailof Island to the outermost point on Glacier Spit, is limited to gill nets.

4. Commercial fishing for herring in Halibut Cove Lagoon is limited to set gill nets not exceeding 50 fathoms in length, hung measure. All such nets shall be anchored in a substantial manner not less than 150 yards apart.

5. Nets operated within areas marked at the north and south ends of Halibut Cove Lagoon shall be anchored at right angles to the line joining the markers. Nets operated between these areas shall be anchored in a general direction paralleling the shore line.

6. The maintaining of a herring pound or the dumping of offal and dead herring in the waters of Halibut Cove and Lagoon is prohibited.

7. The use of purse seines for the capture of herring is prohibited in Kachemak Bay and tributary waters within a line from Nubble Point to Bluff Point.

8. Gill nets used in catching herring shall not be of smaller mesh than 3 inches stretched measure.

9. Commercial fishing for herring, including bait fishing, by means of any trap is prohibited.

10. Commercial fishing for herring, including bait fishing, by means of any purse seine more than 1,400 meshes in depth, more than 180 fathoms in length, or of mesh less than 1½ inches stretched measure between knots is prohibited.

11. No one shall place, or cause to be placed, across the entrance of any lagoon or bay any net or other device which will prevent the free passage at all times of herring in and out of said lagoon or bay.

Clam fishery.—It is prohibited to take for commercial purposes any razor clam measuring less than 4½ inches in total length of shell. Possession of any razor clam of less than this length will be regarded as prima facie evidence of unlawful taking.

VIII. Resurrection Bay Area

The Resurrection Bay area is hereby defined to include all territorial coastal and tributary waters of the Gulf of Alaska between Point Gore on the west and Cape Fairfield on the east.

Salmon fishery.—1. The use of any trap for the capture of salmon is prohibited.

2. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 200 fathoms hung measure.

3. No set or anchored gill net shall exceed 300 yards in length, and each shall be set in substantially a straight line: *Provided*, That not to exceed 20 yards of each net may be used as a hook. Only one such hook is permitted on a net. There shall be a distance interval of at least 200 yards, both endwise and laterally, at all times between all set or anchored gill nets operated.

4. King salmon nets shall have a mesh at least 8½ inches stretched measure between knots, and red salmon nets shall have a mesh at least 5½ inches stretched measure between knots, as measured when actually in use.

5. No boat used in operating any purse seine shall be longer than 50 feet, as shown by official register length.

6. Prior to 6 o'clock antemeridian June 6 in each year commercial fishing for salmon with nets of mesh less than 8½ inches stretched measure between knots is prohibited.

7. Commercial fishing for salmon is prohibited during the remainder of each calendar year after 6 o'clock, postmeridian September 22.

8. In the waters of Resurrection Bay, within a line from Cape Resurrection to the western side of Bear Glacier at its mouth, the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock postmeridian of Friday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 60 hours: *Provided*, That this extension shall not be effective after August 23 in each year.

9. Commercial fishing for salmon within 1,000 yards of the mouths of Bear Creek and Resurrection River is prohibited at all times; and in the period from June 7 to August 23, both dates inclusive, commercial fishing for salmon is prohibited within 1,700 yards of the mouths of these streams.

Steelhead fishery.—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

Clam fishery.—It is prohibited to take for commercial purposes any razor clam measuring less than 4½ inches in total length of shell. Possession of any razor clam of less than this length will be regarded as prima facie evidence of unlawful taking.

IX. Prince William Sound Area

The Prince William Sound area is hereby defined to include all territorial coastal and tributary waters of the Gulf of Alaska between Cape Fairfield on the west and Point Whitshed on the east.

Salmon fishery.—1. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 200 fathoms hung measure.

2. No salmon fishing boat shall carry or operate more than one seine of any description, and no additional net of any kind shall be carried on such boat. The carrying of any additional seine or net of any kind on a boat towed by any salmon fishing boat is prohibited. No purse seine shall be less than 125 meshes nor more than 150 meshes in depth, nor less than 90 fathoms nor more than 150 fathoms in length measured on the cork line. For the purpose of determining depths of seines, measurements will be upon the basis of 3½ inches stretched measure between knots. No extension to any seine in the way of leads will be permitted.

3. No boat used in operating any purse seine shall be longer than 50 feet, as shown by official register length.

4. No set or anchored gill net shall exceed 300 yards in length and each shall be set in substantially a straight line: *Provided*, That not to exceed 20 yards of each net may be used as a hook. Only one such hook is permitted on a net. There shall be a distance interval of at least 200 yards both endwise and laterally at all times between all set or anchored gill nets operated.

5. The use of purse seines and beach seines for the capture of salmon is prohibited in the waters along the western coast, from the outer point on the north shore of Granite Bay (known as Granite Bay Point) to the light on the south shore of the entrance to Port Nellie Juan.

6. The 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock antemeridian of Saturday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 48 hours.

7. Commercial fishing for salmon, except by trolling from boats propelled wholly by oars or sails, is prohibited prior to 6 o'clock antemeridian June 20 in each calendar year: *Provided*, That in Drier Bay below Williams Creek this prohibition shall not apply to commercial fishing for salmon after May 28 in each calendar year.

8. Commercial fishing for salmon is prohibited during the remainder of each calendar year after 6 o'clock antemeridian August 2, except that in the waters along the western coast from the outer point on the north shore of Granite Bay (known as Granite Bay Point) to the light on the south shore of the entrance to Port Nellie Juan commercial fishing for salmon by trolling and gill netting is permitted through August 15. All trap leads from shore to entrance of hearts must be removed prior to 6 o'clock antemeridian August 6.

9. The distance by most direct water measurement from any part of one trap to any part of another trap shall not be less than 1½ statute miles.

10. Commercial fishing for salmon in the waters of Port Fidalgo east of 146 degrees 20 minutes west longitude is prohibited after 6 o'clock antemeridian July 11 in each year.

11. The use of any trap for the capture of salmon is prohibited except as follows:

(*a*) Along the coast of Squire Island within ½ statute mile of its southern extremity.

(*b*) Eastern coast of Chenega Island from a point 1 statute mile southward of its northern extremity to a point 1 statute mile eastward of Chenega village.

(*c*) The coast within 1 statute mile eastward of the point where the one hundred and forty-eighth meridian of west longitude intersects the north shore of Granite Bay, west coast of Prince William Sound.

(*d*) Eastern coast of Culross Island: (1) Within 5,000 feet northeasterly of a point on the southeast coast at 148 degrees 8 minutes 45 seconds west longitude; and (2) from the northern side of the entrance to Hidden Bay northerly to a point at 60 degrees 45 minutes north latitude, 148 degrees 8 minutes 30 seconds west longitude.

(*e*) Within 1 statute mile eastward of the southwestern extremity of Naked Island.

(*f*) Along the mainland eastward and northward from the outermost extremity of Point Pellew to 60 degrees 51 minutes north latitude.

(*g*) Along the mainland within 1 statute mile of the outer extremity of Granite Point, near Fairmount Island.

(*h*) Western side of Valdez Arm from Point Freemantle to 60 degrees 59 minutes north latitude.

(*i*) From the north side of the entrance to Sawmill Bay to a point on the coast 1 statute mile northeastward.

(*j*) Southwest coast of Bligh Island from 60 degrees 49 minutes 45 seconds north latitude to 146 degrees 44 minutes 20 seconds west longitude.

(*k*) Within ½ statute mile of the southwestern extremity of Bidarka Point.

(*l*) From a point on the east side of Landlocked Bay at 60 degrees 49 minutes north latitude to a point on the north shore of Port Fidalgo at 146 degrees 32 minutes west longitude.

(*m*) Within ½ statute mile of the northern extremity of the land between Two Moon Bay and Snug Corner Cove.

(*n*) Within ½ statute mile of Porcupine Point.

(*o*) Goose Island: West coast between the northern and southern extremities of the island.

(*p*) Mainland coast from a point at 60 degrees 41 minutes 51 seconds north latitude, 146 degrees 40 minutes 22 seconds west longitude, to a point east of Knowles Head at 146 degrees 36 minutes 20 seconds west longitude.

(*q*) Within 1 statute mile of Red Head.

(*r*) From a point on the coast 1 statute mile northwestward of the light at Gravina Point to a point on the coast 2 statute miles northwestward of the light at Gravina Point, making an open space of 1 statute mile.

(*s*) Along the coast within 1 statute mile southwesterly of the outer point on the southwest side of the entrance to Cedar Bay, Hawkins Island.

(*t*) Within 1 statute mile of Makaka Point, Hawkins Island.

(*u*) Hinchinbrook Island: Within 3,000 feet, measured westerly along the north side of a peninsula, from a point at 60 degrees 28 minutes 47 seconds north latitude, 146 degrees 23 minutes 27 seconds west longitude.

(*v*) Hinchinbrook Island: Within 3,000 feet, measured easterly along the coast, from a point at 60 degrees 27 minutes 58 seconds north latitude, 146 degrees 27 minutes west longitude, on the north side of a spit.

(*w*) Hinchinbrook Island: Within 2,500 feet, measured along the coast, from a point at 60 degrees 28 minutes 54 seconds north latitude, 146 degrees 32 minutes 11 seconds west longitude.

(*x*) Hinchinbrook Island: From a point on the coast at 60 degrees 27 minutes north latitude, 146 degrees 39 minutes 48 seconds west longitude, northward to the light at Johnstone Point.

(*y*) Hinchinbrook Island: From a point on the coast 2½ statute miles north of the southwestern extremity of Bear Cape northward to a point at 60 degrees 24 minutes 53 seconds north latitude, 146 degrees 42 minutes 24 seconds west longitude.

(*z*) Hinchinbrook Island: Within ½ statute mile eastward of a point on the south side of Port Etches at 146 degrees 40 minutes west longitude.

(*aa*) Montague Island: Along the coast within 2,500 feet from a point at 59 degrees 47 minutes north latitude, 147 degrees 56 minutes west longitude.

(*bb*) Montague Island: Along the coast from a point on the south side of Macleod Harbor 2,500 feet easterly of the outer extremity of Point Bryant to a point at 59 degrees 50 minutes 49 seconds north latitude, 147 degrees 54 minutes 27 seconds west longitude.

(*cc*) Western coast of Montague Island from Point Woodcock to a point on the south side of Hanning Bay at 147 degrees 42 minutes 40 seconds west longitude.

(*dd*) Western coast of Montague Island from the north side of the entrance to Hanning Bay northeasterly to 60 degrees 9 minutes 45 seconds north latitude (as shown on U. S. Coast and Geodetic Survey chart No. 8550).

(*ee*) Western coast of Montague Island from a point at 60 degrees 10 minutes 20 seconds north latitude northeasterly to a point at 60 degrees 12 minutes 17 seconds north latitude, 147 degrees 17 minutes 15 seconds west longitude (as shown on U. S. Coast and Geodetic Survey chart No. 8550).

(*ff*) Northern coast of Montague Island from Graveyard Point to a point on the coast ½ statute mile westerly of Montague Point.

12. All commercial fishing for salmon is prohibited, as follows:

(*a*) Constantine Harbor, northwest arm of Port Etches: All waters within the harbor and its tributary waters and within 100 yards outside the narrows at the entrance to the harbor.

(*b*) Anderson Bay and Double Bay, north shore of Hinchinbrook Island: All waters within the bays.

(*c*) Port Etches: All waters within 2 statute miles of the mouth of the salmon stream flowing into the head of Port Etches.

(*d*) Boswell Bay, indenting Hinchinbrook Island: All waters in the bay west of 146 degrees 8 minutes west longitude.

(*e*) Twin Lake Creek: All waters within 1,000 yards of the mouth of Twin Lake Creek flowing into the southeast arm of Simpson Bay.

(*f*) Gravina River: All waters within 1 statute mile of the mouth of the river.

(g) Olsen Bay, north side of Port Gravina: All waters within 2,000 yards of the mouth of the stream flowing into the head of the bay.

(h) St. Matthew Bay, north side of Port Gravina: All waters within 2,000 yards of the mouth of the stream flowing into the head of the bay.

(i) Irish Cove, south side of Port Fidalgo: All waters within the cove south of 60 degrees 46 minutes north latitude.

(j) Port Fidalgo: All waters within 1,000 yards of the mouth of the stream at the head of Port Fidalgo.

(k) Fish Bay, north side of Port Fidalgo: All waters within 1,000 yards of the mouth of the stream at the head of the bay.

(l) Galena Bay, east side of Valdez Arm: All waters within 2,000 yards of the mouth of Duck River and all waters within 1,000 yards of the mouth of Indian Creek.

(m) Jack Bay, east side of Valdez Arm: All waters east of 146 degrees 36 minutes west longitude.

(n) Robe River, Lowe River, and other unnamed streams flowing into Port Valdez in the immediate vicinity of Valdez: All waters within 1 statute mile of the mouths.

(o) Columbia Bay, Long Bay, and their tributaries, indenting mainland on north shore of Prince William Sound: All waters within 1,000 yards of the mouth of any salmon stream.

(p) Unakwik Inlet, indenting mainland on north shore of Prince William Sound: All waters north of an east and west line passing through the northern side of the entrance to Jonah Bay and all waters of the inlet within 1,000 yards of the mouth of any salmon stream.

(q) Siwash Bay, west side of Unakwik Inlet: All waters within the bay.

(r) Coghill River, tributary to College Fiord: All waters within 2,000 yards outside of the mouth of the river.

(s) Pigot Bay, west side of Port Wells: All waters within the bay.

(t) Long Bay, tributary to Culross Passage: All waters within the bay.

(u) Gumboot Creek, on northwest shore of Eshamy Bay: All waters within 1,000 yards of the mouth of the creek.

(v) Eshamy Lagoon and its tributary waters: All waters within the lagoon and its tributaries and within 100 yards outside the narrows at the entrance to the lagoon.

(w) Jackpot Bay: All waters within a line, indicated by markers, passing through one of the islands at the entrance to Jackpot Bay from Dangerous Passage.

(x) Port Bainbridge: All waters in the middle north arm of Port Bainbridge.

(y) Crab Bay, on north shore of Evans Bay, Evans Island: All waters within 1,000 yards of the mouth of any salmon stream.

(z) Bay of Isles, indenting east shore of Knight Island: All waters within the west arm of the bay.

Steelhead fishery.—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

Herring fishery.—1. Commercial fishing for herring, except for bait purposes, is prohibited from January 1 to June 30, both dates inclusive, and from November 16 to December 31, both dates inclusive, except that gill nets with mesh of not less than 2½ inches stretched measure between knots may be used from November 16 to December 15, both dates inclusive.

2. During the period from July 1 to October 1, both dates inclusive, commercial fishing for herring, including bait fishing, is prohibited in all waters closed throughout the year to salmon fishing.

3. Gill nets used in catching herring shall not be of smaller mesh than 2¼ inches stretched measure.

4. Commercial fishing for herring, including bait fishing, by means of any trap is prohibited.

5. Commercial fishing for herring, including bait fishing, by means of any purse seine more than 1,400 meshes in depth, more than 180 fathoms in length, or of mesh less than 1½ inches stretched measure between knots is prohibited.

6. No one shall place, or cause to be placed, across the entrance of any lagoon or bay any net or other device which will prevent the free passage at all times of herring in and out of said lagoon or bay.

Clam fishery.—1. It is prohibited to take for commercial purposes any razor clam measuring less than 4½ inches in total length of shell. Possession of any razor clam of less than this length will be regarded as prima facie evidence of unlawful taking.

2. The taking of clams for commercial purposes is prohibited from 6 o'clock postmeridian July 15 to 6 o'clock postmeridian August 31 in each calendar year.

CRAB FISHERY—DUNGENESS CRAB (*Cancer magister*).—No female of this species shall be taken at any time, and no male of this species measuring less than 6½ inches in greatest width shall be taken for commercial purposes.

X. COPPER RIVER AREA

The Copper River area is hereby defined to include all territorial coastal and tributary waters of Alaska between Point Whitshed on the west and Point Martin on the east, including Egg Islands and the other islands between these points.

SALMON FISHERY.—1. Commercial fishing for salmon is prohibited from 6 o'clock postmeridian July 5 to 6 o'clock antemeridian August 10 in each year.

2. Prior to 6 o'clock antemeridian May 15 in each year commercial fishing with nets of mesh less than 8½ inches stretched measure between knots is prohibited.

3. From May 15 to July 5, both dates inclusive, the 36 hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock antemeridian of Saturday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 48 hours.

4. Commercial fishing for salmon is prohibited after 6 o'clock postmeridian September 22 in each calendar year.

5. Commercial fishing for salmon shall be conducted solely by drift gill nets, except that gill nets attached to anchored boats or other anchored floating equipment and stake nets may also be used from 6 o'clock antemeridian August 10 to 6 o'clock postmeridian September 22 in each calendar year.

6. Prior to 6 o'clock antemeridian August 10 in each calendar year the total aggregate length of drift gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 250 fathoms hung measure: *Provided*, That during the period from 6 o'clock antemeridian May 15 to 6 o'clock postmeridian May 31 any gill net boat on the Copper River flats may carry and operate not to exceed 100 fathoms of net of mesh not less than 8½ inches stretched measure between knots in addition to 250 fathoms of smaller mesh net.

7. Commercial fishing for salmon is prohibited within 500 yards of the Grass Banks, except that from 6 o'clock antemeridian August 10 to 6 o'clock postmeridian September 22 in each calendar year such fishing is permitted within 500 yards of the Grass Banks by means of gill nets and stake nets not exceeding 300 fathoms each in length: *Provided*, That all stakes, pegs to which guy wires or lines are attached, or other pieces of equipment used in connection with stake nets shall be removed at or before the end of the fishing season. All fishing is prohibited at all times within the sloughs and within 500 yards of their mouths.

8. Stake and anchored gill nets shall be operated in substantially a straight line.

STEELHEAD FISHERY.—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

CLAM FISHERY.—1. It is prohibited to take for commercial purposes any razor clam measuring less than 4½ inches in total length of shell. Possession of any razor clam of less than this length will be regarded as prima facie evidence of unlawful taking.

2. The taking of clams for commercial purposes is prohibited from 6 o'clock postmeridian July 15 to 6 o'clock postmeridian August 31 in each calendar year.

CRAB FISHERY—DUNGENESS CRAB (*Cancer magister*).—No female of this species shall be taken at any time, and no male of this species measuring less than 6½ inches in greatest width shall be taken for commercial purposes.

XI. BERING RIVER AREA

The Bering River area is hereby defined to include all territorial coastal and tributary waters of Alaska between Point Martin on the west and Cape Suckling on the east.

SALMON FISHERY.—1. In the Bering River area all commercial fishing for salmon is prohibited prior to 6 o'clock antemeridian August 10 in each year: *Provided*, That this prohibition shall not prevent the taking of fish for local food requirements or for use as dog feed.

2. Commercial fishing for salmon is prohibited after 6 o'clock postmeridian September 22 in each calendar year.

3. Stake and anchored gill nets shall be operated in substantially a straight line.

4. Commercial fishing for salmon by means of any trap is prohibited.

STEELHEAD FISHERY.—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon.

CLAM FISHERY.—It is prohibited to take for commercial purposes any razor clam measuring less than 4½ inches in total length of shell. Possession of any razor clam of less than this length will be regarded as prima facie evidence of unlawful taking.

XII. SOUTHEASTERN ALASKAN AREA

The Southeastern Alaska area is hereby defined to include all territorial coastal and tributary waters of Alaska extending from Dixon Entrance on the south to and including Yakutat Bay on the north.

SALMON FISHERY.—This area is subdivided into the following districts, wherein regulations shall be effective as follows:

Yakutat district.—All territorial waters within a line extending from Cape Fairweather at 58 degrees 49 minutes north latitude, 138 degrees west longitude, to Mount Fairweather, thence following the international boundary to a point at 140 degrees 28 minutes west longitude, thence south to a point at 59 degrees 36 minutes north latitude, 140 degrees 28 minutes west longitude, thence to Cape Fairweather at the point of beginning.

1. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 150 fathoms hung measure.

2. Stake and anchored gill nets shall be operated in substantially a straight line.

3. In Dry Bay the use of any drift gill net more than 60 fathoms in length or more than 35 meshes in depth is prohibited. Except in Dry Bay the use of any drift gill net more than 40 fathoms in length or more than 35 meshes in depth is prohibited. For the purpose of determining depths of drift gill nets measurements will be upon the basis of 5½ inches stretched measure.

4. In Dry Bay, Situk Inlet, and the lagoon between Ahrnklin and Situk Inlets no stake, set, or anchored gill net shall exceed 25 fathoms in length measured on the cork line.

5. Commercial fishing for salmon by means of any gill net having mesh of more than 5½ inches stretched measure between knots is prohibited in Situk Inlet prior to August 10 in each year.

6. No salmon fishing boat shall carry or operate more than one seine of any description, and no additional net of any kind shall be carried on such boat. The carrying of any additional seine or net of any kind on a boat towed by any salmon fishing boat is prohibited.

7. Commercial fishing for salmon by means of any beach seine less than 75 fathoms hung measure in length or less than 4 fathoms hung measure in depth is prohibited. For the purpose of determining depths of seines measurements will be upon the basis of 3½ inches stretched measure between knots.

8. Commercial fishing for salmon in Dry Bay is prohibited prior to May 15 in each year.

9. Commercial fishing for salmon, except in Dry Bay, is prohibited prior to June 24 in each year: *Provided,* That this prohibition shall not apply to trolling.

10. Commercial fishing for salmon, except by trolling, is prohibited for the remainder of each calendar year after September 30.

11. Commercial fishing for salmon, except by trolling, is prohibited in all lagoons and other waters outside or between the mouths of Situk and Ahrnklin rivers for the remainder of each calendar year after 6 o'clock postmeridian September 20.

12. Commercial fishing for salmon by trolling, except from boats propelled wholly by oars or sails, is prohibited prior to March 1 in each calendar year.

13. In commercial trolling operations no king salmon shall be caught which when dressed will weigh less than 6 pounds. In the event any such undersized salmon are thus taken, they must be carefully removed from the hook without jerking or other action causing injury and returned to the water alive.

14. The use of any trap or purse seine is prohibited.

15. No trolling boat shall operate more than four trolling lines.

16. The 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock postmeridian of Friday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 60 hours.

17. All commercial fishing for salmon is prohibited, as follows:

(*a*) Ankau Creek and Inlet.

(*b*) Akwe or Ahquay River.

(*c*) The "Basin" above Dry Bay.

Icy Strait district.—All territorial waters within a line extending from a point west of Yakobi Island at 58 degrees north latitude, 136 degrees 51 minutes west longitude, to a point at 58 degrees north latitude, 134 degrees 58 minutes west longitude, thence north to a point on the coast of Chichagof Island near Point Augusta at 58 degrees 2 minutes 43 seconds north latitude, 134 degrees 58 minutes west longitude, thence to the southeastern extremity of Point Couverden, thence to Mount Harris, thence following the international boundary to Mount Fairweather, thence to Cape Fairweather at 58 degrees 49 minutes north latitude, 138 degrees west longitude, thence to the point of beginning at 58 degrees north latitude, 136 degrees 51 minutes west longitude.

1. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 250 fathoms hung measure.

2. Stake and anchored gill nets shall be operated in substantially a straight line.

3. The distance by most direct water measurement from any part of one trap to any part of another trap shall not be less than 1½ statute miles.

4. No floating trap shall exceed 900 feet in length when any part of such trap is in a greater depth of water than 100 feet at mean high tide. The length of any such trap shall be as measured along the lead from shore at mean high tide to the outer face of the pot.

5. No salmon fishing boat shall carry or operate more than one seine of any description, and no additional net of any kind shall be carried on such boat. The carrying of any additional seine or net of any kind on a boat towed by any salmon fishing boat is prohibited. No purse seine shall be less than 175 meshes nor more than 250 meshes in depth nor less than 150 fathoms nor more than 200 fathoms in length, measured on the cork line. For the purpose of determining depths of seines measurements will be upon the basis of 3½ inches stretched measure between knots. No extension to any seine in the way of leads will be permitted.

6. Commercial fishing for salmon, other than trolling, is prohibited prior to 6 o'clock antemeridian June 15 in each calendar year and for the remainder of each calendar year after 6 o'clock postmeridian August 3: *Provided,* That in the waters of Icy Strait and its tributaries easterly of a line from Point Adolphus to Point Gustavus the closing date shall be 6 o'clock postmeridian August 6.

7. Commercial fishing for salmon by trolling is prohibited from 6 o'clock antemeridian August 25 to 6 o'clock postmeridian September 20 in each year.

8. Commercial fishing for salmon by trolling, except from boats propelled wholly by oars or sails, is prohibited prior to March 1 in each calendar year.

9. In commercial trolling operations no king salmon shall be caught which when dressed will weight less than 6 pounds. In the event any such undersized salmon are thus taken, they must be carefully removed from the hook without jerking or other action causing injury and returned to the water alive.

10. The use of any beach seine is prohibited.

11. No boat used in operating any purse seine shall be longer than 50 feet, as shown by official register length.

12. No trolling boat shall operate more than four trolling lines.

13. Commercial fishing for salmon, except by gill nets, is prohibited in Dundas Bay north of 58 degrees 21 minutes north latitude, also in the western section of the bay southward of that latitude.

14. Commercial fishing for salmon by means of any seine is prohibited in Idaho Inlet south of 58 degrees 8 minutes 12 seconds north latitude.

15. Commercial fishing for salmon is prohibited in Port Frederick, northern shore of Chichagof Island, in all waters east of a line from Inner Point Sophia to Game Point and in all waters south of 58 degrees 4 minutes north latitude, except that trolling will be permitted from November 1 to June 1, both dates inclusive. A portion of the waters closed is in the western district.

16. The use of any trap for the capture of salmon is prohibited, except as follows:

(*a*) Mainland: From the east side of Dundas Bay at 58 degrees 20 minutes north latitude to a point 1,000 feet east of Point Dundas.

(*b*) Inian Islands: (1) North of 58 degrees 15 minutes 42 seconds north latitude, exclusive of the east end of the northeastern island and the east and north coasts of the northwestern island easterly of the light at the northwest end; and (2) southwest coast of the northwestern island between 58 degrees 15 minutes 42 seconds north latitude and 58 degrees 15 minutes 18 seconds north latitude.

(*c*) George Islands: That island of the George Islands group located at 58 degrees 12 minutes 18 seconds north latitude.

(*d*) Island west of Three Hill Island, Cross Sound: Shore of island west of Three Hill Island located at 58 degrees 10 minutes 3 seconds north latitude, 136 degrees 24 minutes 42 seconds west longitude.

(*e*) Chichagof Island: East coast of Port Althorp between 58 degrees 9 minutes 42 seconds and 58 degrees 11 minutes north latitude.

(*f*) Chichagof Island: From a point easterly of Point Lavinia at 58 degrees 13 minutes 2 seconds north latitude, 136 degrees 20 minutes west longitude, easterly to a point at 58 degrees 13 minutes 18 seconds north latitude, 136 degrees 17 minutes 36 seconds west longitude.

(*g*) Chichagof Island: From a point on the east side of Idaho Inlet at 58 degrees 12 minutes 18 seconds north latitude northward and eastward to 136 degrees 6 minutes 18 seconds west longitude.

(*h*) Chichagof Island: North coast within 1,000 feet westerly from Eagle Point.

(*i*) Chichagof Island: North coast from a point 1,000 feet southerly from Pinta Cove Point westward to a point on the east side of Mud Bay at 58 degrees 12 minutes 6 seconds north latitude.

(*j*) Lemesurier Island: Northwest coast between the western and the northern extremities of the island.

(*k*) Mainland: From Point Gustavus to 135 degrees 50 minutes west longitude.

(*l*) Pleasant Island: Southern coast from the western extremity of the island easterly to 135 degrees 33 minutes 10 seconds west longitude.

(*m*) Mainland: From a point on the east side of Excursion Inlet at 58 degrees 23 minutes north latitude southward to 135 degrees 8 minutes 40 seconds west longitude.

(*n*) Chichagof Island: Northeastern coast from Point Sophia to a point on the south side of Icy Strait at 135 degrees 11 minutes 20 seconds west longitude.

(*o*) Chichagof Island: Northeastern coast from a point on the south side of Icy Strait at 135 degrees 2 minutes 40 seconds west longitude easterly to a point at 58 degrees 2 minutes 43 seconds north latitude, 134 degrees 58 minutes west longitude.

17. All commercial fishing for salmon is prohibited in Glacier Bay within a line from Point Carolus to Point Gustavus.

Western district.—All territorial waters within a line extending from a point off Cape Ommaney at 56 degrees 6 minutes north latitude, 134 degrees 51 minutes west longitude, to a point off Cape Edgecumbe at 57 degrees north latitude, 136 degrees 4 minutes west longitude, thence to a point at 58 degrees north latitude, 136 degrees 51 minutes west longitude, thence east to 134 degrees 58 minutes west longitude, thence north to a point on the coast of Chichagof Island near Point Augusta at 58 degrees 2 minutes 43 seconds north latitude, 134 degrees 58 minutes west longitude, thence to the southeastern extremity of Point Couverden, thence to Mount Harris, thence following the international boundary to Mount Ogilvie, thence to the northern extremity of Shelter Island, thence to the northern extremity of Mansfield Peninsula, thence following the watersheds on Mansfield Peninsula and Admiralty Island to the southern extremity of Point Gardner, thence west to the watershed on Baranof Island, thence following the watershed to the southern extremity of Cape Ommaney, thence to the point of beginning at 56 degrees 6 minutes north latitude, 134 degrees 51 minutes west longitude.

1. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 250 fathoms hung measure.

2. Stake and anchored gill nets shall be operated in substantially a straight line.

3. The distance by most direct water measurement from any part of one trap to any part of another trap shall not be less than 1 statute mile.

4. No floating trap shall exceed 900 feet in length when any part of such trap is in a greater depth of water than 100 feet at mean high tide. The length of any such trap shall be as measured along the lead from shore at mean high tide to the outer face of the pot.

5. No salmon fishing boat shall carry or operate more than one seine of any description, and no additional net of any kind shall be carried on such boat. The carrying of any additional seine or net of any kind on a boat towed by any salmon fishing boat is prohibited. No purse seine shall be less than 175 meshes nor more than 250 meshes in depth, nor less than 150 fathoms nor more than 200 fathoms in length measured on the cork line. For the purpose of determining depths of seines measurements will be upon the basis of 3½ inches

stretched measure between knots. No extension to any seine in the way of leads will be permitted.

6. Commercial fishing for salmon, other than trolling, is prohibited prior to 6 o'clock antemeridian June 15 in each calendar year and for the remainder of each calendar year after 6 o'clock postmeridian August 10: *Provided*, That commercial fishing for salmon south of 58 degrees north latitude is permitted from 6 o'clock antemeridian October 1 to 6 o'clock postmeridian October 15: *and provided further*, That this prohibition shall not apply to the use of gill nets from 6 o'clock antemeridian September 5 to 6 o'clock postmeridian September 30 in Lynn Canal and contiguous waters north of the north end of Sullivan Island, including Chilkat Inlet outside of a line from Green Point passing across the southern shore of Pyramid Island and Chilkoot Inlet, 1,000 yards outside the mouth of Chilkoot River.

7. Commercial fishing for salmon by trolling is prohibited from 6 o'clock antemeridian August 25 to 6 o'clock postmeridian September 20 in each year: *Provided*, That this prohibition shall not apply along the west coast of Baranof Island from Cape Ommaney to the south point of entrance to Whale Bay.

8. Commercial fishing for salmon by means of any trap is prohibited except in the period from 6 o'clock antemeridian June 15 to 6 o'clock postmeridian August 10 in each year.

9. Commercial fishing for salmon by trolling, except from boats propelled wholly by oars or sails, is prohibited prior to March 1 in each calendar year.

10. The use of any beach seine is prohibited.

11. No boat used in operating any purse seine shall be longer than 50 feet, as shown by official register length.

12. No trolling boat shall operate more than four trolling lines.

13. In commercial trolling operations no king salmon shall be caught which when dressed will weigh less than 6 pounds. In the event any such undersized salmon are thus taken, they must be carefully removed from the hook without jerking or other action causing injury and returned to the water alive.

14. Purse seines are prohibited in Lynn Canal and contiguous waters north of 58 degrees 26 minutes north latitude.

15. Commercial fishing for salmon in Chilkat Inlet north of the south end of Kochu Island is prohibited, except that in these closed waters outside of a line from Green Point passing across the southern shore of Pyramid Island such fishing is permitted by gill nets from 6 o'clock antemeridian September 5 to 6 o'clock post meridian September 30 in each year.

16. Commercial fishing for salmon in Chilkoot Inlet and contiguous waters north of 59 degrees 14 minutes 39 seconds north latitude is prohibited, except that in these closed waters outside of 1,000 yards of the mouth of Chilkoot River such fishing is permitted by gill nets from 6 o'clock antemeridian September 5 to 6 o'clock postmeridian September 30 in each year.

17. Commercial fishing for salmon is prohibited in Tenakee Inlet and Freshwater Bay within a line from North Passage Point to South Passage Point: *Provided*, That this prohibition shall not apply to trolling from January 1 to 6 o'clock postmeridian August 24.

18. Commercial fishing for salmon is prohibited in Port Frederick, northern shore of Chichagof Island, in all waters east of a line from Inner Point Sophia to Game Point, and in all waters south of 58 degrees 4 minutes north latitude, except that trolling will be permitted from November 1 to June 1, both dates inclusive. A portion of the waters closed is in the Icy Strait district.

19. The use of any trap for the capture of salmon is prohibited, except as follows:

(*a*) Krugloi Islands, Salisbury Sound: Along the coast on the south side of that island of the Krugloi Islands group located at 57 degrees 21 minutes 44 seconds north latitude, 135 degrees 43 minutes 26 seconds west longitude.

(*b*) Baranof Islands: Northwest coast, beginning at a point 1,000 yards southward of Point Kakul and extending southward ½ statute mile.

(*c*) Chichagof Island: Eastern coast from a point at 58 degrees 2 minutes 8 seconds north latitude, 134 degrees 56 minutes 26 seconds west longitude, southerly to North Passage Point, exclusive of False Bay.

(*d*) Chichagof Island: Eastern coast from South Passage Point to Point Hayes, exclusive of Basket Bay and within ½ statute mile of each side of its entrance.

(*e*) Baranof Island: From a point ½ statute mile south of Point Thatcher to Point Lull.

(*f*) Baranof Island: East coast from a point ½ statute mile southeasterly of South Point to the north side of the entrance to Kasnyku Bay, exclusive of Cosmos Cove.

(*g*) Baranof Island: East coast from a point at the south side of the entrance to Kasnyku Bay at 57 degrees 12 minutes north latitude to a point 1 statute mile northwesterly of Point Turbot.

(*h*) Mansfield Peninsula: West coast from 58 degrees 22 minutes 6 seconds north latitude southerly to 58 degrees 19 minutes 35 seconds north latitude.

(*i*) Mansfield Peninsula: West coast from 58 degrees 18 minutes 35 seconds north latitude southerly to 58 degrees 15 minutes 20 seconds north latitude.

(*j*) Mansfield Peninsula: West coast from the south point of entrance to Funter Bay to the southern extremity of the peninsula at the north side of the entrance to Hawk Inlet.

(*k*) Admiralty Island: West coast from a point ¾ statute mile north of Parker Point to 58 degrees 2 minutes north latitude.

(*l*) Admiralty Island: West coast from Village Point to Distant Point.

(*m*) Admiralty Island: West coast from a point north of Wilson Cove at 57 degrees 10 minutes 30 seconds north latitude to Point Caution.

20. All commercial fishing for salmon is prohibited, as follows:

(*a*) Wilson Cove, southwestern shore of Admiralty Island: All waters within the cove.

(*b*) Whitewater Bay, southwestern shore of Admiralty Island: All waters within a line from Point Caution to Woody Point.

(*c*) Chaik Bay, southwestern shore of Admiralty Island: All waters east of 134 degrees 29 minutes west longitude.

(*d*) Warm Spring Bay, eastern shore of Baranof Island: All waters within the bay.

(*e*) Kelp Bay, east coast of Baranof Island: All waters in Middle Arm, and all waters in South Arm west of 134 degrees 57 minutes west longitude.

(*f*) Hanus Bay, northeast shore of Baranof Island: All waters in the bay south of a line from Point Hanus to Point Moses.

(*g*) Rodman Bay, northeast coast of Baranof Island: All waters west of 135 degrees 22 minutes west longitude.

(*h*) Sitkoh Bay, southeast shore of Chichagof Island: All waters within 1,000 yards of the mouths of all salmon streams.

(*i*) Basket Bay, east coast of Chichagof Island: All waters within the bay.

(*j*) Hawk Inlet, west coast of Admiralty Island: All waters of the inlet and its tributaries.

(*k*) Salt Lake Lagoon, Takanis Bay, southwest shore of Yakobi Island: All waters in the Lagoon and within 500 yards of its mouth.

(*l*) Redfish Bay, southwest shore of Baranof Island: All waters above a true east and west line passing through the southern end of the Second Narrows.

(*m*) Still Harbor, west coast of Baranof Island: All waters in the harbor.

(*n*) Port Banks, off Whale Bay, west coast of Baranof Island: All waters in Port Banks.

(*o*) Redoubt Bay, west coast of Baranof Island: All waters within 1,000 yards of the mouth of the stream flowing from Redoubt Lake.

Eastern district.—All territorial waters within a line extending from a point near the Hazy Islands at 55 degrees 54 minutes north latitude, 134 degrees 34 minutes west longitude, to the southern end of Cape Decision, thence following the watershed on Kuiu Island to a point on the east side of Kuiu Island at 56 degrees 40 minutes north latitude, 133 degrees 44 minutes 15 seconds west longitude, thence east across Keku Strait, thence across Kupreanof Island, passing north of Duncan Canal, to a point on the east coast of Kupreanof Island at 56 degrees 54 minutes north latitude, thence across Frederick Sound to Horn Cliffs on the mainland, thence to Castle Mountain, thence following the international boundary to Mount Ogilvie, thence to the northern extremity of Shelter Island, thence to the northern extremity of Mansfield Peninsula, thence following the watersheds on Mansfield Peninsula and Admiralty Island to the southern extremity of Point Gardner, thence west to the watershed on Baranof Island, thence following the watershed to the southern extremity of Cape Ommaney, thence to a point at 56 degrees 6 minutes north latitude, 134 degrees 51 minutes west longitude, thence to the point of beginning at 55 degrees 54 minutes north latitude, 134 degrees 34 minutes west longitude.

1. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 250 fathoms hung measure.

2. Stake and anchored gill nets shall be operated in substantially a straight line.

3. The distance by most direct water measurements from any part of one trap to any part of another trap shall not be less than 1 statute mile.

4. No floating trap shall exceed 900 feet in length when any part of such trap is in a greater depth of water than 100 feet at mean high tide. The length of any such trap shall be as measured along the lead from shore at mean high tide to the outer face of the pot.

5. No salmon fishing boat shall carry or operate more than one seine of any description, and no additional net of any kind shall be carried on such boat. The carrying of any additional seine or net of any kind on a boat towed by any salmon fishing boat is prohibited. No purse seine shall be less than 175 meshes nor more than 250 meshes in depth, nor less than 150 fathoms nor more than 200 fathoms in length measured on the cork line. For the purpose of determining depths of seines measurements will be upon the basis of 3½ inches stretched measure between knots. No extension to any seine in the way of leads will be permitted.

6. Commercial fishing for salmon, except by trolling, is prohibited prior to 6 o'clock antemeridian June 25 in each calendar year: *Provided*, That this prohibition shall not apply to the use of gill nets in Taku Inlet after 6 o'clock antemeridian May 10.

7. Commercial fishing for salmon, other than trolling, is prohibited for the remainder of each calendar year after 6 o'clock postmeridian August 14: *Provided*, That commercial fishing for salmon south of 58 degrees north latitude is permitted from 6 o'clock antemeridian October 1 to 6 o'clock postmeridian October 15.

8. Commercial fishing for salmon by trolling is prohibited from 6 o'clock antemeridian August 25 to 6 o'clock postmeridian September 20 in each year: *Provided*, That this prohibition shall not apply along the east coast of Baranof Island from Cape Ommaney to the outer extremity of Armstrong Point.

9. Commercial fishing for salmon by means of any trap is prohibited except in the period from 6 o'clock antemeridian June 25 to 6 o'clock postmeridian August 14 in each year.

10. Commercial fishing for salmon by trolling, except from boats propelled wholly by oars or sails, is prohibited prior to March 1 in each calendar year.

11. The use of any beach seine is prohibited.

12. No boat used in operating any purse seine shall be longer than 50 feet, as shown by official register length.

13. No trolling boat shall operate more than four trolling lines.

14. In commercial trolling operations no king salmon shall be caught which when dressed will weigh less than 6 pounds. In the event any such undersized salmon are thus taken, they must be carefully removed from the hook without jerking or other action causing injury and returned to the water alive.

15. Purse seines are prohibited in Lynn Canal and contiguous waters north of 58 degrees 26 minutes north latitude.

16. No gill net used in Taku Inlet shall exceed 150 fathoms in length hung measure.

17. The use of any trap for the capture of salmon is prohibited, except as follows:

(*a*) Douglas Island: Within 5,000 feet northwesterly from Middle Point.

(*b*) Mainland: From the south side of Limestone Inlet at 58 degrees 1 minute 30 seconds north latitude southward to a point at 57 degrees 59 minutes 10 seconds north latitude.

(*c*) Mainland, east side of Stephens Passage: From a point on the north side of Windham Bay at 133 degrees 33 minutes west longitude to Point League.

(*d*) Mainland, between Hobart Bay and Windham Bay; From a point at 57 degrees 26 minutes 20 seconds north latitude to a point at 57 degrees 30 minutes north latitude.

(*e*) Mainland: From a point on the north side of Port Houghton at 133 degrees 26 minutes west longitude to a point north of Point Hobart at 57 degrees 23 minutes north latitude.

(*f*) Mainland, Frederick Sound: From a point on the south side of Fanshaw Bay at 133 degrees 32 minutes 30 seconds west longitude to Cape Fanshaw, thence southeasterly to a point at 57 degrees 7 minutes 23 seconds north latitude, 133 degrees 21 minutes west longitude, excluding coast between 133 degrees 23 minutes west longitude and 133 degrees 26 minutes west longitude.

(*g*) Admiralty Island: Southeast coast from Point Pybus to False Point Pybus, exclusive of coast between a point at 57 degrees 18 minutes 50 seconds north latitude and a point at 57 degrees 20 minutes north latitude, 133 degrees 55 minutes west longitude.

(*h*) Admiralty Island: Southeast coast from a point at 57 degrees 12 minutes north latitude southward to Deepwater Point.

(*i*) Admiralty Island: Southeast coast from a point ½ statute mile southwest of Point Brightman to a point at 57 degrees 3 minutes 19 seconds north latitude, 134 degrees 27 minutes 20 seconds west longitude.

(*j*) Admiralty Island: Southeast coast within 2,500 feet northeasterly of the southern extremity of Walker Point.

(*k*) Kupreanof Island: Northwest coast from a point ½ statute mile southeast of the outer extremity of Point Macartney northward to a point on the north shore at 57 degrees 5 minutes 50 seconds north latitude, 133 degrees 54 minutes west longitude, excluding coast between 133 degrees 58 minutes west longitude and 133 degrees 55 minutes 30 seconds west longitude.

(*l*) Kuiu Island: Within ¼ statute mile of the western extremity of Cornwallis Point.

(*m*) Kuiu Island: Northwest coast from a point 1 statute mile north of the north side of the entrance to Washington Bay northward to the point at the east side of the entrance to Band Cove.

18. All commercial fishing for salmon is prohibited as follows:

(*a*) Port Houghton, indenting mainland: All waters in Sanborn Canal.

(*b*) Windham Bay, indenting mainland: All waters of the bay within a line 1,000 yards outside the mouth of the narrows.

(*c*) Taku Inlet: All waters to the eastward of a line beginning on the shore northward of Taku Point at 133 degrees 59 minutes west longitude, thence running due north to the opposite shore, thence following the shore line to the mouth of the Taku River.

(*d*) Mole Harbor, tributary to Seymour Canal, east coast of Admiralty Island: All waters of the harbor west of 134 degrees 2 minutes 25 seconds west longitude.

(*e*) Gambier Bay, east coast of Admiralty Island: All waters west of 134 degrees west longitude.

(*f*) Portage Bay, north end of Kupreanof Island: All waters within the bay and all waters within 1 statute mile outside the entrance to the bay.

(*g*) Port Camden, east coast of Kuiu Island: All waters of Port Camden south of 56 degrees 40 minutes north latitude

(*h*) Kadake Bay, east coast of Kuiu Island: All waters of Kadake Bay within a line from a point at 56 degrees 48 minutes 20 seconds north latitude, 133 degrees 56 minutes 18 seconds west longitude, to a point at 56 degrees 48 minutes 40 seconds north latitude, 133 degrees 57 minutes 30 seconds west longitude.

(*i*) Hamilton Bay, west coast of Kupreanof Island: All waters east of 133 degrees 49 minutes west longitude.

(*j*) Keku Strait, east coast of Kuiu Island: Waters of Keku Strait, including all waters of Big Johns Bay, inclosed by a line from a point at 56 degrees 35 minutes north latitude, 133 degrees 42 minutes 35 seconds west longitude, to a point at 56 degrees 35 minutes north latitude, 133 degrees 40 minutes west longitude, and a line from the northern extremity of Point Camden to a point at 56 degrees 48 minutes 40 seconds north latitude, 133 degrees 46 minutes west longitude. A portion of the closed waters of Big Johns Bay is north of 56 degrees 48 minutes 40 seconds north latitude. A part of the waters closed is in the North Prince of Wales Island district.

(*k*) Tebenkof Bay, west coast of Kuiu Island: All waters in north arm of bay.

(*l*) Bay of Pillars, west coast of Kuiu Island: All waters in south arm of bay.

(*m*) Security Bay, northwest coast of Kuiu Island: All waters within 1,000 yards of all salmon streams.

(*n*) Saginaw Bay, northwest coast of Kuiu Island: All waters of the bay inside of a line beginning at the point of land at the northwest side of the entrance to Halleck Harbor and passing in a southwesterly direction at right angles to the general trend of the bay to the opposite shore.

(*o*) Red Bluff Bay, east coast of Baranof Island: All waters in the bay; the waters of Falls Creek Bay are included.

(*p*) Gut Bay, east coast of Baranof Island: All waters of the bay.

(*q*) Little Port Walter, east coast of Baranof Island: All waters in Little Port Walter.

Stikine district.—All territorial waters within a line extending from Horn Cliffs on the mainland to Frederick Point on Mitkof Island, thence to Point Howe, thence to South Craig Point on Zarembo Island, thence to Drag Island in Chichagof Pass, thence to Chichagof Peak on Wrangell Island, thence to Babbler Point on the mainland, thence to Mount Cote, thence following the international boundary to Castle Mountain, thence to the point of beginning at Horn Cliffs.

1. Commercial fishing for salmon shall be conducted solely by trolling and by drift gill nets which shall not be less than 125 fathoms in length nor more than 250 fathoms in length each.

2. Commercial fishing for salmon, except by trolling, is prohibited during the period from 6 o'clock postmeridian June 10 to 6 o'clock postmeridian June 30 in each year and for the remainder of each year after 6 o'clock postmeridian September 30.

3. From April 1 to September 30, both dates inclusive, the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock antemeridian of Saturday of each week to 6 o'clock antemeridian of the Monday following, making a weekly closed period of 48 hours.

4. Commercial fishing for salmon by trolling, except from boats propelled wholly by oars or sails, is prohibited prior to March 1 in each calendar year.

5. No trolling boat shall operate more than four trolling lines.

6. In commercial trolling operations no king salmon shall be caught which when dressed will weigh less than 6 pounds. In the event any such undersized salmon are thus taken, they must be carefully removed from the hook without jerking or other action causing injury and returned to the water alive.

North Prince of Wales Island district.—All territorial waters within a line extending from a point near the Hazy Islands at 55 degrees 54 minutes north latitude, 134 degrees 34 minutes west longitude, to the southern end of Cape Decision, thence following the watershed on Kuiu Island to a point on the east side of Kuiu Island at 56 degrees 40 minutes north latitude, 133 degrees 44 minutes 15 seconds west longitude, thence east across Keku Strait, thence across Kupreanof Island, passing north of Duncan Canal, to a point on the east coast of Kupreanof Island at 56 degrees 54 minutes north latitude, thence across Frederick Sound to Horn Cliffs on the mainland, thence to Frederick Point on Mitkof Island, thence to Point Howe, thence to South Craig Point on Zarembo Island, thence to Drag Island in Chichagof Pass, thence to Chichagof Peak on Wrangell Island, thence to Babbler Point on the mainland, thence to Mount Cote, thence following the international boundary to Mount Lewis Cass, thence southerly and westerly along the watershed to the southern extremity of Caamano Point, thence southerly to the international boundary at 131 degrees 44 minutes west longitude, thence westerly to the southern extremity of Cape Chacon, thence in a northwesterly direction along the watershed of Prince of Wales Island to a point at 55 degrees 35 minutes 30 seconds north latitude, 133 degrees 14 minutes west longitude, thence south to a point at 55 degrees 25 minutes 30 seconds north latitude, 133 degrees 14 minutes west longitude, thence west to 55 degrees 25 minutes 30 seconds north latitude, 134 degrees west longitude, thence to the point of beginning at 55 degrees 54 minutes north latitude, 134 degrees 34 minutes west longitude.

1. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 250 fathoms hung measure.

2. Stake and anchored gill nets shall be operated in substantially a straight line.

3. The distance by most direct water measurement from any part of one trap to any part of another trap shall not be less than 1 statute mile.

4. No floating trap shall exceed 900 feet in length when any part of such trap is in a greater depth of water than 100 feet at mean high tide. The length of any such trap shall be as measured along the lead from shore at mean high tide to the outer face of the pot.

5. No salmon fishing boat shall carry or operate more than one seine of any description, and no additional net of any kind shall be carried on such boat. The carrying of any additional seine or net of any kind on a boat towed by any salmon fishing boat is prohibited. No purse seine shall be less than 175 meshes nor more than 250 meshes in depth nor less than 150 fathoms nor more than 200 fathoms in length, measured on the cork line. For the purpose of determining depths of seines measurements will be upon the basis of 3½ inches stretched measure between knots. No extension to any seine in the way of leads will be permitted.

6. Commercial fishing for salmon, other than trolling, is prohibited prior to 6 o'clock antemeridian July 10 in each calendar year, from 6 o'clock postmeridian August 20 to 6 o'clock antemeridian October 1 in each year, and for the remainder of each calendar year after 6 o'clock postmeridian October 15.

7. Commercial fishing for salmon by trolling is prohibited from 6 o'clock antemeridian August 25 to 6 o'clock postmeridian September 20 in each year.

8. Commercial fishing for salmon by means of any trap is prohibited except in the period from 6 o'clock antemeridian July 10 to 6 o'clock postmeridian August 20 in each year.

9. Commercial fishing for salmon by trolling, except from boats propelled wholly by oars or sails, is prohibited prior to March 1 in each calendar year.

10. The use of any beach seine is prohibited.

11. No boat used in operating any purse seine shall be longer than 50 feet, as shown by official register length.

12. No trolling boat shall operate more than four trolling lines.

13. In commercial trolling operations no king salmon shall be caught which when dressed will weigh less than 6 pounds. In the event any such undersized salmon are thus taken, they must be carefully removed from the hook without jerking or other action causing injury and returned to the water alive.

14. The use of any gill net is prohibited in all waters of the west coast of Prince of Wales Island and adjacent islands northward to Point Baker.

15. Commercial fishing for salmon, except by trolling, is prohibited in Anita Bay, opening into Zimovia Strait, Etolin Island.

16. Commercial fishing for salmon is prohibited in all waters of Wrangell Narrows between Point Alexander and Prolewy Point: *Provided*, That this prohibition shall not apply to trolling other than by power boats northeasterly of a line from a point on Mitkof Island at 56 degrees 48 minutes 17 seconds north latitude, 132 degrees 58 minutes 34 seconds west longitude, to a point on Kupreanof Island at 56 degrees 48 minutes 40 seconds north latitude, 132 degrees 59 minutes 20 seconds west longitude.

17. The use of any trap for the capture of salmon is prohibited, except as follows:

(*a*) San Juan Bautista Island: From a point on the west coast at 55 degrees 25 minutes 45 seconds north latitude southerly and easterly to a point on the south coast at 55 degrees 24 minutes north latitude, 133 degrees 18 minutes 30 seconds west longitude. A part of these waters is in the South Prince of Wales Island district.

(*b*) Noyes Island: North coast between 133 degrees 40 minutes west longitude and 133 degrees 42 minutes 16 seconds west longitude.

(*c*) San Fernando Island: Northern coast from Point Garcia to a point on the coast 1 statute mile west of Point Santa Lucia.

(*d*) San Fernando Island: Southeastern coast from a point on the coast 1½ statute miles southwest of Fern Point to Point Amargura.

(*e*) Culebra Island: Coast west of 133 degrees 26 minutes 30 seconds west longitude.

(*f*) St. Philip Island: Coast west of 133 degrees 25 minutes west longitude.

(*g*) Blanquizal Island: Coast west of 133 degrees 24 minutes west longitude.

(*h*) Prince of Wales Island: Coast along San Christoval Channel from a point at 55 degrees 37 minutes north latitude southward to 133 degrees 16 minutes west longitude.

(*i*) Esquibel Island: East coast from the southern extremity of the island to a point at 55 degrees 38 minutes 40 seconds north latitude.

(*j*) Heceta Island: Western and southern coasts from a point on the coast 1½ statute miles southeasterly from Cape Lynch to a point on the coast at 55 degrees 42 minutes 40 seconds north latitude, 133 degrees 29 minutes 20 seconds west longitude, excluding coast from a point at 55 degrees 41 minutes 30 seconds north latitude, 133 degrees 31 minutes 40 seconds west longitude, to a point at 55 degrees 42 minutes 15 seconds north latitude, 133 degrees 29 minutes 45 seconds west longitude.

(*k*) Heceta Island: Northern shore from a point on the east side of Port Alice at 55 degrees 49 minutes 45 seconds north latitude to the point at approximately 55 degrees 49 minutes 10 seconds north latitude and 133 degrees 31 minutes west longitude.

(*l*) Tuxekan Island: Western coast from a point at 55 degrees 52 minutes 50 seconds north latitude southerly to a point at 55 degrees 52 minutes 15 seconds north latitude.

(*m*) Tuxekan Island: Western coast within 1,000 feet of the western extremity of Turn Point.

(*n*) Tuxekan Island: Western coast within 3,000 feet northwesterly of a point 1,000 feet northwesterly of the southern extremity of Tuxekan Island.

(*o*) Kosciusko Island: Western coast from a point 1,000 feet northwesterly from the southern extremity of land at the west side of Halibut Harbor to 55 degrees 56 minutes north latitude.

(*p*) Kosciusko Island: Western coast (1) within 5,000 feet southerly of Ruins Point at 56 degrees 4 minutes north latitude, (2) within 5,000 feet northerly of 55 degrees 59 minutes 40 seconds north latitude, and (3) the small islet at the north point of the entrance to Pole Anchorage.

(*q*) Kosciusko Island: Eastern coast from a point ½ statute mile west of Van Sant Cove to a point ½ statute mile east of the east side of the entrance to Edna Bay.

(*r*) Cap Island, near Tuxekan Island: West side of Cap Island from the southern extremity to a point on the north shore at 133 degrees 21 minutes west longitude.

(*s*) Warren Island, near Kosciusko Island: East coast of Warren Island between 55 degrees 51 minutes north latitude and 55 degrees 56 minutes north latitude, exclusive of Warren Cove and False Cove.

(*t*) Kuiu Island: From a point on the coast 2 statute miles northeasterly from Cape Decision to a point on the coast near the entrance to Port McArthur at 56 degrees 3 minutes north latitude.

(*u*) Kuiu Island: East coast within 2,500 feet from a point at 56 degrees 13 minutes 19 seconds north latitude, 133 degrees 52 minutes 35 seconds west longitude.

(*v*) Kuiu Island: East coast of peninsula between Port Beauclerc and Reid Bay from 56 degrees 17 minutes north latitude northward to 56 degrees 19 minutes north latitude.

(*w*) Prince of Wales Island: Northwest coast from a point at 56 degrees 17 minutes north latitude southerly to a point ½ statute mile northerly from the entrance to Hole in the Wall.

(*x*) Barrier Islands, near northwest coast of Prince of Wales Island: The west coast of the westerly of the two principal islands of the Barrier Islands group.

(*y*) Prince of Wales Island: North coast between 133 degrees 22 minutes west longitude and 133 degrees 33 minutes 30 seconds west longitude.

(*z*) Prince of Wales Island: North coast from Pine Point to Point Colpoys.

(*aa*) Kupreanof Island: Southern coast within 2,500 feet from a point at 56 degrees 26 minutes 8 seconds north latitude, 133 degrees 29 minutes 35 seconds west longitude.

(*bb*) Zarembo Island: West coast from Point St. John to 56 degrees 24 minutes 20 seconds north latitude.

(*cc*) Zarembo Island: West coast from 56 degrees 20 minutes north latitude southeasterly to a point on the coast at 133 degrees west longitude.

(*dd*) Etolin Island: West coast from 56 degrees 18 minutes north latitude southward to Steamer Point.

(*ee*) Etolin Island: West coast within 2,500 feet northeasterly from a point on the coast at 56 degrees 11 minutes 39 seconds north latitude.

(*ff*) Etolin Island: West coast from 56 degrees 9 minutes 15 seconds north latitude southward to 56 degrees 8 minutes north latitude.

(*gg*) Etolin Island: West coast from 56 degrees 4 minutes 30 seconds north latitude southeasterly to 56 degrees 3 minutes north latitude, 132 degrees 38 minutes 54 seconds west longitude.

(*hh*) West coast of Observation Island, Marsh Island, Screen Islands, and Abraham Island.

(*ii*) East Island: East coast within 2,500 feet of a point at 56 degrees 10 minutes north latitude, 132 degrees 54 minutes 16 seconds west longitude.

(*jj*) Blashke Island: Coast west of 132 degrees 55 minutes west longitude.

(*kk*) Coffman Island: East coast between the northern and the southern extremities.

(*ll*) Prince of Wales Island: Within ½ statute mile southeastward of the extremity of land at approximately 56 degrees 1 minute 16 seconds north latitude, 132 degrees 49 minutes 40 seconds west longitude.

(*mm*) Prince of Wales Island: East coast from a point ½ statute mile northwest of Luck Point to a point at 55 degrees 52 minutes 25 seconds north latitude, exclusive of 1 statute mile each side of the mouth of Eagle Creek.

(*nn*) Prince of Wales Island: East coast from a point at 55 degrees 51 minutes 25 seconds north latitude southeasterly to a point at 55 degrees 50 minutes 45 seconds north latitude.

(*oo*) Prince of Wales Island: East coast from a point at 55 degrees 49 minutes 15 seconds north latitude southeasterly to a point at 55 degrees 46 minutes 30 seconds north latitude.

(*pp*) Onslow Island: West coast from Gull Point to Ernest Point.

(*qq*) Brownson Island: From the southern extremity of the island eastward and northward to 55 degrees 57 minutes north latitude.

(*rr*) Cleveland Peninsula: West coast from ½ statute mile east of Watkins Point southward to a point 1 statute mile north of Emerald Bay.

(*ss*) Deer Island: West coast from a point at 56 degrees 3 minutes north latitude to Kuakan Point.

(*tt*) Cleveland Peninsula: East side of Clarence Strait within 2,000 feet southerly of a point at 55 degrees 45 minutes 43 seconds north latitude, 132 degrees 17 minutes 10 seconds west longitude.

(*uu*) Cleveland Peninsula: From a point on the east side of Clarence Strait at 55 degrees 44 minutes 7 seconds north latitude, 132 degrees 15 minutes 36 seconds west longitude, southerly to Caamano Point, thence northeasterly to a point at 55 degrees 34 minutes 5 seconds north latitude near the south side of the entrance to Smugglers Cove. A part of these waters is in the southern district.

(*vv*) Grindall Island, off Grindall Point, Prince of Wales Island: Within 3,500 feet northwesterly of the eastern extremity of Approach Point, and on the south side of Grindall Island within ⅛ statute mile of a point at 55 degrees 26 minutes 20 seconds north latitude, 132 degrees 8 minutes 10 seconds west longitude.

(*ww*) Prince of Wales Island: East coast from the eastern end of Grindall Point at 55 degrees 27 minutes 30 seconds north latitude northwesterly to a point southeasterly of Tolstoi Point at 55 degrees 39 minutes 30 seconds north latitude.

(*xx*) Prince of Wales Island: East coast from the northern extremity of Clover Point to a point at 55 degrees 22 minutes 17 seconds north latitude, 132 degrees 11 minutes 40 seconds west longitude, and within 2,500 feet southerly of a point at 55 degrees 23 minutes 35 seconds north latitude, 132 degrees 14 minutes west longitude.

(*yy*) Prince of Wales Island: East coast from 55 degrees 8 minutes 20 seconds north latitude to the northern extremity of Chasina Point, including Wedge Island.

(*zz*) Prince of Wales Island: East coast from Point Halliday to Adams Point.

(*aaa*) Prince of Wales Island: East coast from Ingraham Point to Rip Point, including Polk Island.

(*bbb*) Prince of Wales Island: East coast from 54 degrees 57 minutes north latitude to the south side of the entrance to Ingraham Bay.

(*ccc*) Prince of Wales Island: From the outer point of land on the north side of Kendrick Bay at approximately 131 degrees 58 minutes 30 seconds west longitude northward to 54 degrees 55 minutes 10 seconds north latitude.

(*ddd*) Prince of Wales Island: From Island Point northward to a point on the south side of Kendrick Bay at 132 degrees west longitude.

(*eee*) Prince of Wales Island: East coast from McLean Point to a point 3,500 feet southward.

(*fff*) Prince of Wales Island: From a point near Nichols Bay at 132 degrees 5 minutes west longitude eastward and northward to a point at approximately 54 degrees 45 minutes north latitude, 132 degrees west longitude. A part of these waters is in the South Prince of Wales Island district.

18. All commercial fishing for salmon is prohibited, as follows:

(*a*) Moira Sound, east coast of Prince of Wales Island: All waters in South Arm, Frederick Cove, Kegan Cove, and within 1,000 yards of the mouths of all salmon streams in Johnson Cove.

(*b*) Dolomi Bay, tributary to Port Johnson, east coast of Prince of Wales Island: All waters within the outermost points of the bay.

(*c*) Cholmondeley Sound, east coast of Prince of Wales Island: All waters in Dora Bay and Sunny Cove.

(*d*) Skowl Arm, Prince of Wales Island: All waters within a line from Old Kasaan village to Khayyam Point.

(*e*) Twelvemile Arm, Kasaan Bay: All waters tributary to the west side of Twelvemile Arm within a line from a point at 55 degrees 27 minutes 10 seconds north latitude, 132 degrees 40 minutes west longitude, to a point at 55 degrees 28 minutes 41 seconds north latitude, 132 degrees 38 minutes 30 seconds west longitude.

(*f*) Kasaan Bay, east coast of Prince of Wales Island: All waters north of a line from Sandy Point to the east shore of the bay.

(*g*) Thorne and Tolstoi Bays, indenting the eastern shore of Prince of Wales Island: All waters within a line from Tolstoi Point to Thorne Head.

(*h*) Eagle Creek, about 1 mile south of Luck Point, northeast coast of Prince of Wales Island: All waters within 1 statute mile of the mouth of the creek.

(*i*) Barnes Lake, at head of Lake Bay, northeast coast of Prince of Wales Island: All waters in Barnes Lake and within 50 yards outside its entrance. .

(*j*) Whale Passage, northeast coast of Prince of Wales Island: All waters within 1,000 yards from mouths of all salmon streams.

(*k*) Salmon Bay, northeast coast of Prince of Wales Island: All waters within the bay and all waters within 1 statute mile of the mouth of the bay.

(*l*) Red Bay, north shore of Prince of Wales Island: All waters south of a true east and west line passing through the north shore of Dead Island.

(*m*) McHenry Inlet, southwest coast of Etolin Island: All waters within 1,000 yards of the salmon streams emptying into the head of McHenry Inlet.

(*n*) Rocky Bay, west coast of Etolin Island: All waters within 1 statute mile of the head of the bay.

(*o*) Olive Cove, indenting the northeastern shore of Etolin Island.

(*p*) Thoms Place, indenting the southwestern shore of Wrangell Island, Zimovia Strait.

(*q*) Bradfield Canal: All waters of Bradfield Canal to the eastward of a line from Point Warde to the point at the east side of the entrance to Fools Inlet.

(*r*) Blake Channel and Eastern Passage: All waters between Bradfield Canal and a line from Babbler Point to a point on Wrangell Island at 56 degrees 27 minutes 50 seconds north latitude, 132 degrees 17 minutes 15 seconds west longitude.

(*s*) Duncan Canal, Kupreanof Island: All waters within 1 statute mile of all salmon streams tributary to Duncan Canal.

(*t*) Barrie Creek, north of Point Barrie, southwest shore of Kupreanof Island: All waters within 1 statute mile of the mouth of the creek.

(*u*) Keku Strait, east coast of Kuiu Island: Waters of Keku Strait, including all waters of Big Johns Bay, enclosed by a line from a point at 56 degrees 35 minutes north latitude, 133 degrees 42 minutes 35 seconds west longitude, to a point at 56 degrees 35 minutes north latitude, 133 degrees 40 minutes west longitude, and a line from the northern extremity of Point Camden to a point at 56 degrees 48 minutes 40 seconds north latitude, 133 degrees 46 minutes west longitude. A portion of the closed waters of Big Johns Bay is north of 56 degrees 48 minutes 40 seconds north latitude. A part of the waters closed is in the eastern district.

(*v*) Three Mile Arm, east coast of Kuiu Island: All waters within 1,000 yards of the mouths of all salmon streams.

(*w*) Seclusion Harbor, east coast of Kuiu Island: All waters within the outermost points of the harbor.

(*x*) Port Beauclerc, southeastern coast of Kuiu Island: All waters within 1,000 yards of the mouths of all salmon streams tributary to Port Beauclerc.

(*y*) Affleck Canal, southeastern coast of Kuiu Island: All waters within 1,000 yards of the mouths of all salmon streams tributary to Affleck Canal and all waters north of 56 degrees 13 minutes 30 seconds north latitude.

(*z*) Hole in the Wall, west coast of Prince of Wales Island: All waters within the outermost points of the cove.

(*aa*) Calder Bay, west coast of Prince of Wales Island: All waters north of 56 degrees 11 minutes 6 seconds north latitude.

(*bb*) El Capitan Passage, between Kosciusko Island and Prince of Wales Island: El Capitan Passage and contiguous waters between a line extending due east from a point on the west side of Tenass Pass at 56 degrees north latitude and a line extending due north from the point of land on Kosciusko Island at 56 degrees 8 minutes 47 seconds north latitude, 133 degrees 27 minutes 40 seconds west longitude.

(*cc*) Shipley Bay, west coast of Kosciusko Island: All waters east of 133 degrees 33 minutes 8 seconds west longitude.

(*dd*) Davidson Inlet, Kosciusko Island: All waters of the inlet north of 56 degrees 1 minute 45 seconds north latitude.

(*ee*) Tokeen Bay, Kosciusko Island: All waters of the bay north of 56 degrees 1 minute 45 seconds north latitude.

(*ff*) Sarkar Cove, west coast of Prince of Wales Island, tributary to El Capitan Passage: All waters inside of a line across the entrance.

(*gg*) Naukati Bay, west coast of Prince of Wales Island: All waters within the bay.

(*hh*) Staney Creek, west coast of Prince of Wales Island: All waters within 1 statute mile of the mouth of the creek.

South Prince of Wales Island district.—All territorial waters within a line extending from a point west of Cape Addington at 55 degrees 25 minutes 30 seconds north latitude, 134 degrees west longitude, thence to a point southwest of Forrester Island at 54 degrees 40 minutes north latitude, 133 degrees 35 minutes west longitude, thence to the southern extremity of Cape Muzon, thence to the southern extremity of Cape Chacon, thence in a northwesterly direction along the watershed of Prince of Wales Island to a point at 55 degrees 35 minutes 30 seconds north latitude, 133 degrees 14 minutes west longitude, thence south to a point at 55 degrees 25 minutes 30 seconds north latitude, 133 degrees 14 minutes west longitude, thence west to the point of beginning at 55 degrees 25 minutes 30 seconds north latitude, 134 degrees west longitude.

1. The total aggregate length of gill nets on any salmon-fishing boat, or in use by such boat, shall not exceed 250 fathoms hung measure.

2. Stake and anchored gill nets shall be operated in substantially a straight line.

3. The distance by most direct water measurement from any part of one trap to any part of another trap shall not be less than 1 statute mile.

4. No floating trap shall exceed 900 feet in length when any part of such trap is in a greater depth of water than 100 feet at mean high tide. The length of any such trap shall be as measured along the lead from shore at mean high tide to the outer face of the pot.

5. No salmon-fishing boat shall carry or operate more than one seine of any description, and no additional net of any kind shall be carried on such boat. The carrying of any additional seine or net of any kind on a boat towed by any salmon-fishing boat is prohibited. No purse seine shall be less than 175 meshes nor more than 250 meshes in depth nor less than 150 fathoms nor more than 200 fathoms in length, measured on the cork line. For the purpose of determining depths of seines measurements will be upon the basis of $3\frac{1}{2}$ inches stretched measure between knots. No extension to any seine in the way of leads will be permitted.

6. Commercial fishing for salmon, other than trolling, is prohibited prior to 6 o'clock antemeridian July 15 in each calendar year, from 6 o'clock postmeridian August 24 to 6 o'clock antemeridian October 1 in each year, and for the remainder of each calendar year after 6 o'clock postmeridian October 15.

7. Commercial fishing for salmon by trolling is prohibited from 6 o'clock antemeridian August 25 to 6 o'clock postmeridian September 20 in each year.

8. Commercial fishing for salmon by means of any trap is prohibited except in the period from 6 o'clock antemeridian July 15 to 6 o'clock postmeridian August 24 in each year.

9. Commercial fishing for salmon by trolling, except from boats propelled wholly by oars or sails, is prohibited prior to March 1 in each calendar year.

10. The use of any beach seine is prohibited.

11. No boat used in operating any purse seine shall be longer than 50 feet, as shown by official register length.

12. No trolling boat shall operate more than four trolling lines.

13. In commercial trolling operations no king salmon shall be caught which when dressed will weigh less than 6 pounds. In the event any such undersized salmon are thus taken, they must be carefully removed from the hook without jerking or other action causing injury and returned to the water alive.

14. The use of any gill net is prohibited in all waters of the west coast of Prince of Wales Island and adjacent islands from Cape Chacon northward.

15. The use of any trap for the capture of salmon is prohibited, except as follows:

(*a*) San Juan Bautista Island: Within 2,000 feet of a point on the east coast at 55 degrees 24 minutes 27 seconds north latitude, 133 degrees 15 minutes west longitude.

(*b*) San Juan Bautista Island: From a point on the west coast at 55 degrees 25 minutes 45 seconds north latitude southerly and easterly to a point on the south coast at 55 degrees 24 minutes north latitude, 133 degrees 18 minutes 30 seconds west longitude. A part of these waters is in the North Prince of Wales Island district.

(*c*) St. Ignace Island: Within ⅜ statute mile of the southern extremity of the island.

(*d*) Baker Island: East coast (1) within 2,500 feet of a point at 55 degrees 20 minutes 50 seconds north latitude, 133 degrees 31 minutes 32 seconds west longitude; and (2) from Point Maria to Point Capones.

(*e*) Suemez Island: Northern coast from Point Arboleda to a point at 55 degrees 20 minutes north latitude and approximately 133 degrees 19 minutes west longitude.

(*f*) Prince of Wales Island: Coast from Point Providence to a point on the coast between Tranquil Point and Point Batan at 133 degrees 13 minutes west longitude.

(*g*) Dall Island: East coast from 54 degrees 59 minutes north latitude to 55 degrees 30 seconds north latitude.

(*h*) Dall Island: From Kaigani Village to a point on the coast 1 statute mile northwestward.

(*i*) Long Island, east of Dall Island: East and west coasts between 54 degrees 46 minutes north latitude and 54 degrees 47 minutes north latitude.

(*j*) Sukkwan Island: Southwestern coast from 55 degrees 2 minutes 30 seconds north latitude to the southern extremity of the island, exclusive of the waters of Kasook Inlet and its tributaries and branches.

(*k*) Prince of Wales Island: From a point at 54 degrees 59 minutes 25 seconds north latitude, 132 degrees 36 minutes 45 seconds west longitude, southerly to a point at 54 degrees 58 minutes 50 seconds north latitude, 132 degrees 36 minutes 55 seconds west longitude, and from Point Webster southeasterly to 54 degrees 54 minutes 45 seconds north latitude, exclusive of the waters of Kassa Inlet and its tributaries and branches.

(*l*) Ship Islands, Cordova Bay: West coast of the western of the two largest islands of the Ship Islands group and within 300 yards west of the southern extremity of the eastern large island of this group.

(*m*) Coast line within 450 feet of the eastern extremity of the island situated at 54 degrees 42 minutes 51 seconds north latitude, 132 degrees 16 minutes 15 seconds west longitude.

(*n*) Prince of Wales Island: South coast within 600 feet northeasterly from the extremity of land at 54 degrees 43 minutes 5 seconds north latitude, 132 degrees 13 minutes 35 seconds west longitude.

(*o*) Prince of Wales Island: South coast between Brownson Bay and Nichols Bay from a point at 54 degrees 42 minutes 30 seconds north latitude, 132 degrees 10 minutes west longitude, easterly to a point at 54 degrees 41 minutes 22 seconds north latitude, 132 degrees 8 minutes west longitude.

(*p*) Prince of Wales Island: From a point near Nichols Bay at 132 degrees 5 minutes west longitude eastward and northward to a point at approximately 54 degrees 45 minutes north latitude, 132 degrees west longitude. A part of these waters is in the North Prince of Wales Island district.

16. All commercial fishing for salmon is prohibited, as follows:

(*a*) Klawak Inlet, west coast of Prince of Wales Island: All waters in the head of the inlet east of 133 degrees 5 minutes west longitude.

(*b*) Klawak Harbor, west coast of Prince of Wales Island: All waters south of 55 degrees 33 minutes 22 seconds north latitude.

(*c*) Trocadero Bay, west coast of Prince of Wales Island: All waters in the bay east of a true north and south line passing through the eastern extremity of the peninsula just south of Copper Mine.

(*d*) North Bay, northeast coast of Dall Island: All waters within 1,000 yards of the mouths of all salmon streams.

(*e*) Sawmill Cove, east coast of Dall Island: All waters of the cove within a line indicated by markers erected for the purpose.

(*f*) Kasook Inlet, southern coast of Sukkwan Island: All waters within 1 statute mile of head of inlet.

(*g*) Hetta Inlet, west coast of Prince of Wales Island: All waters within a true north and south line passing through the western extremity of Gould Island.

(*h*) Deer Bay, Hetta Inlet: All waters within the bay.

(*i*) Copper Harbor, Hetta Inlet: All waters within the harbor.

(*j*) Hetta Harbor, Hetta Inlet: All waters within the harbor.

(*k*) Eek Inlet, Hetta Inlet: All waters within the inlet.

(*l*) Hunter Bay, southwest coast of Prince of Wales Island: All waters of the bay and its tributaries within a line from Turn Point to the southwestern extremity of Gusdagane Point.

Southern district.—All territorial waters within a line beginning at a point on the international boundary at 131 degrees 44 minutes west longitude and following that boundary to Mount Lewis Cass, then southerly and westerly along the watershed to the southern extremity of Caamano Point, thence southerly to the point of beginning on the international boundary at 131 degrees 44 minutes west longitude.

1. The total aggregate length of gill nets on any salmon fishing boat, or in use by such boat, shall not exceed 250 fathoms hung measure.

2. Stake and anchored gill nets shall be operated in substantially a straight line.

3. The distance by most direct water measurement from any part of one trap to any part of another trap shall not be less than 1 statute mile.

4. No floating trap shall exceed 900 feet in length when any part of such trap is in a greater depth of water than 100 feet at mean high tide. The length of any such trap shall be as measured along the lead from shore at mean high tide to the outer face of the pot.

5. No salmon fishing boat shall carry or operate more than one seine of any description, and no additional net of any kind shall be carried on such boat. The carrying of any additional seine or net of any kind on a boat towed by any salmon fishing boat is prohibited. No purse seine shall be less than 175 meshes

nor more than 250 meshes in depth nor less than 150 fathoms nor more than 200 fathoms in length measured on the cork line. For the purpose of determining depths of seines measurements will be upon the basis of 3½ inches stretched measure between knots. No extension to any seine in the way of leads will be permitted.

6. Commercial fishing for salmon, other than trolling, is prohibited prior to 6 o'clock antemeridian July 5 in each calendar year, from 6 o'clock postmeridan August 16 to 6 o'clock antemeridian October 1 in each year, and for the remainder of each calendar year after 6 o'clock postmeridian October 15.

7. Commercial fishing for salmon by trolling is prohibited from 6 o'clock antemeridian August 25 to 6 o'clock postmeridian September 20 in each year.

8. Commercial fishing for salmon by means of any trap is prohibited except in the period from 6 o'clock antemeridian July 5 to 6 o'clock postmeridian August 16 in each year.

9. Commercial fishing for salmon by trolling, except from boats propelled wholly by oars or sails, is prohibited prior to March 1 in each calendar year.

10. The use of any beach seine is prohibited.

11. No boat used in operating any purse seine shall be longer than 50 feet, as shown by official register length.

12. No trolling boat shall operate more than four trolling lines.

13. In commercial trolling operations no king salmon shall be caught which when dressed will weigh less than 6 pounds. In the event any such undersized salmon are thus taken, they must be carefully removed from the hook without jerking or other action causing injury and returned to the water alive.

14. Commercial fishing for salmon by trolling is prohibited in Behm Canal and its tributaries within a line from Point Sykes to Point Alava, across the eastern entrance of the canal, and a line from Point Higgins to Caamano Point, across the western entrance, from 6 o'clock postmeridian April 30 to 6 o'clock postmeridian June 30.

15. Commercial fishing for salmon by trolling is prohibited in Burroughs Bay (indenting mainland north of Revillagigedo Island) for the remainder of each calendar year after 6 o'clock postmeridian August 16: *Provided,* That this prohibition shall not apply to the period from 6 o'clock antemeridian October 1 to 6 o'clock postmeridian October 15 in each year.

16. Commercial fishing for salmon, except by trolling, is prohibited in the waters of Tongass Narrows between a line from Mountain Point to Gravina Point and a line from Point Higgins to Vallenar Point.

17. The use of any trap for the capture of salmon is prohibited, except as follows:

(*a*) Cleveland Peninsula: From a point on the east side of Clarence Strait at 55 degrees 44 minutes 7 seconds north latitude, 132 degrees 15 minutes 36 seconds west longitude, southerly to Caamano Point, thence northeasterly to a point at 55 degrees 34 minutes 5 seconds north latitude near the south side of the entrance to Smugglers Cove. A part of these waters is in the North Prince of Wales Island district.

(*b*) Westerly side of the Vallenar Rock Island located about 800 yards from the northern extremity of Vallenar Point.

(*c*) Gravina Island: Western and southern coasts from South Vallenar Point to a point at 55 degrees 11 minutes 30 seconds north latitude near the south side of the entrance to Bostwick Inlet, including the Bronaugh Islands and the rocky islets adjacent to the west coast of Gravina Island south of South Vallenar Point.

(*d*) Gravina Island: East Coast from Bostwick Point northward to the outer extremity of Blank Point.

(*e*) Annette Island: West coast from a point 1½ statute miles south of Walden Point to Davison Point, including the west shore of Warburton Island.

(*f*) Annette Island: East coast from Reef Point to a point 1 statute mile northeast of Annette Point.

(*g*) Revillagigedo Island: Southwest coast from Carroll Point southward and eastward to a point on the west side of Moth Bay due west of the southern extremity of Moth Point.

(*h*) Revillagigedo Island: From Cone Point southeasterly to a point at 55 degrees 11 minutes 36 seconds north latitude, 131 degrees 10 minutes 42 seconds west longitude, including Cone Island.

(*i*) Revillagigedo Island: Within ½ statute mile of Escape Point, within 5,000 feet northwesterly of Indian Point, and within 1⅛ statute miles northeasterly from a point north of Point Higgins at 55 degrees 27 minutes 45 seconds north latitude, 131 degrees 49 minutes 58 seconds west longtiude.

(*j*) Betton Island: West coast between the southern extremity of the island and 55 degrees 30 minutes north latitude, and from Tatoosh Point northeasterly to the northern extremity of the island.

(*k*) Mainland peninsula between Smeaton Bay and Boca de Quadra: From Point Sykes at 55 degrees 11 minutes 36 seconds north latitude, 131 degrees 5 minutes 30 seconds west longitude, southerly and easterly to a point near Quadra Point at 131 degrees west longitude.

(*l*) Southwestern coast of island located southwesterly from Kah Shakes Point at 55 degrees 2 minutes 42 seconds north latitude, 131 degrees 0 minutes 33 seconds west longitude.

(*m*) Mainland south of Boca de Quadro: Within ⅛ statute mile of a point on Kah Shakes Point at 55 degrees 3 minutes 44 seconds north latitude, 130 degrees 59 minutes 30 seconds west longitude.

(*n*) Mainland south of Kah Shakes Cove: From a point at 55 degrees 1 minute 54 seconds north latitude, 131 degrees west longitude, southward to Kirk Point.

(*o*) Foggy Bay to Cape Fox: From within 1 statute mile northward and eastward of Foggy Point to the southern extremity of Cape Fox, including Cape Fox Island.

(*p*) Duke Island: East coast from a point on the north side of Ray Anchorage at 54 degrees 56 minutes 35 seconds north latitude northward to the outer extremity of Flag Point.

(*q*) Duke Island: East coast from a point on the south shore near Kelp Island at 131 degrees 15 minutes 12 seconds west longitude northward to a point on the south side of Ray Anchorage at 131 degrees 13 minutes west longitude.

(*r*) Duke Island: Southwest coast from a point on the east side of Hall Cove at 54 degrees 53 minutes 24 seconds north latitude to the southern extremity of Cape Northumberland.

(*s*) Percy Islands: Coast along the west and north sides of the westernmost island of the Percy Islands group.

(*t*) Kelp Island: Southern coast between the eastern and western extremities of the island.

(*u*) East Island, east of Kelp Island: Eastern coast between the northern and southern extremities of the island.

(*v*) Mainland east of Cape Fox: Within 2,500 feet southwesterly of a point at 54 degrees 46 minutes 43 seconds north latitude, 130 degrees 48 minutes 16 seconds west longitude.

(*w*) Kanagunut Island: West coast between the northwestern extremity of the island and Garnet Point, and along the east coast within 2,000 feet of Garnet Point.

(*x*) Sitklan Island: Within ½ statute mile of the southern extremity of the island.

18. All commercial fishing for salmon is prohibited, as follows:

(*a*) Hidden Inlet, indenting mainland: All waters in the inlet north of 55 degrees north latitude.

(*b*) Fillmore Inlet, indenting mainland: All waters east of 130 degrees 30 minutes west longitude.

(*c*) Willard Inlet, indenting mainland: All waters north of 54 degrees 56 minutes 30 seconds north latitude.

(*d*) Ray Anchorage, east coast of Duke Island: All waters in Ray Anchorage.

(*e*) Very Inlet, indenting mainland: All waters within the inlet.

(*f*) Boca de Quadra, indenting mainland: All waters within 1 statute mile of the mouth of Sockeye Creek.

(*g*) George Inlet, southern coast of Revillagigedo Island: All waters north of a line from Bat Point to Tsa Cove.

(*h*) Smeaton Bay, indenting mainland: All waters in Wilson and Bakewell Arms east of 130 degrees 40 minutes west longitude.

(*i*) Rudyerd Bay, indenting mainland: All waters in the north arm within 2 statute miles of the mouths of all salmon streams.

(*j*) Walker Cove, indenting mainland, tributary to Behm Canal: All waters within a line from Ledge Point to Hut Point.

(*k*) Chickamin River: All waters within a line from Fish Point to Trap Point.

(*l*) Yes Bay, Cleveland Peninsula: All waters within the bay and all waters outside the entrance within 1,000 yards of a line from Bluff Point to Syble Point.

(*m*) Shrimp Bay, west coast of Revillagigedo Island: All waters east of a line running south from Dress Point to the opposite shore.

(*n*) Traitors Cove, west coast of Revillagigedo Island: All waters of the cove within a line 50 yards outside the neck of the salt-water lagoon.

(*o*) Naha and Moser Bays, west shore of Revillagigedo Island: The waters of Long Arm and Moser Bay inside of a line from Cod Point to the opposite shore at 131 degrees 40 minutes west longitude and the waters of Naha Bay inside of a line extending due north from Cod Point.

(*p*) Raymond Cove, Behm Canal: All waters of the cove within a line from the southern extremity of Mike Point northeasterly to a point at 55 degrees 37 minutes 40 seconds north latitude, 131 degrees 51 minutes 56 seconds west longitude.

Steelhead fishery.—Commercial fishing for steelhead trout shall be subject to the provisions of law and the regulations applicable to commercial fishing for salmon: *Provided*, That, except in respect to weekly close periods, this regulation shall not be effective in the period from March 15 to April 30, both dates inclusive, in waters south of 58 degrees north latitude.

Herring fishery.—1. During the period from June 1 to October 15, both dates inclusive, commercial fishing for herring, including bait fishing, is prohibited in all waters closed throughout the year to salmon fishing.

2. Commercial fishing for herring, except for bait purposes, is prohibited from January 1 to May 31, both dates inclusive, and from October 1 to December 31, both dates inclusive: *Provided*, That this prohibition shall not apply to the use of gill nets of mesh not less than 2¼ inches stretched measure between knots, in the period from October 1 to December 31, both dates inclusive.

3. Commercial fishing for herring, except for bait purposes, is prohibited from 6 o'clock postmeridian of Saturday of each week until 6 o'clock antemeridian of the Monday following.

4. Commercial fishing for herring, including bait fishing, by means of any trap is prohibited.

5. No herring fishing boat shall carry or operate more than one seine of any description, and no additional net of any kind shall be carried on such boat. The carrying of any additional siene or net of any kind on a boat towed by any herring fishing boat is prohibited. These prohibitions shall not apply to pound seines used exclusively for impounding herring or to seines used exclusively within waters enclosed by such pound seines.

6. Commercial fishing for herring, including bait fishing, by means of any purse seine more than 1,200 meshes in depth, more than 180 fathoms in length, or of mesh less than 1½ inches stretched measure between knots is prohibited: *Provided*, That any purse seine may have in addition a strip along the bottom not to exceed 30 meshes in depth and of mesh not less than 4 inches stretched measure between knots. No extension to any seine in the way of leads will be permitted.

7. No one shall place, or cause to be placed, across the entrance to any lagoon or bay any net or other device which will prevent the free passage at all times of herring in and out of said lagoon or bay.

8. All commercial fishing, including bait fishing, for herring is prohibited throughout the year in the waters of Kanalku Bay, Admiralty Island.

9. Commercial fishing for herring, including bait fishing, by means of any beach seine on any herring spawning ground is prohibited.

10. Seines used in commercial fishing, including bait fishing, for herring in Klawak Harbor within a true east and west line passing through the northern extremity of Klawak Island shall not exceed 90 fathoms hung measure in length nor 500 meshes in depth. For the purpose of determining depths of such seines measurements will be upon the basis of 1½ inches stretched measure between knots. No such seine shall have a mesh of less than 1½ inches stretched measure between knots.

Clam fishery.—It is prohibited to take for commercial purposes any razor clam measuring less than 4½ inches in total length of shell. Possession of any razor clam of less than this length will be regarded as prima facie evidence of unlawful taking.

Shrimp fishery.—Commercial fishing for shrimps is prohibited in the period from March 15 to April 30, both dates inclusive, in each year.

Crab fishery—Dungeness crab (*Cancer magister*).—No female of this species shall be taken at any time, and no male of this species measuring less than 6½ inches in greatest width shall be taken for commercial purposes.

GENERAL REGULATIONS

By virtue of the authority conferred by the acts approved June 6, 1924, and June 26, 1906, the following regulations shall be effective in all waters of Alaska, including the special areas already described above:

1. During closed periods the heart walls of all salmon traps within the areas affected shall be lifted or lowered in accordance with the method prescribed by section 5 of the act of June 6, 1924. The tunnels from hearts to pots of all salmon traps shall be constructed of flexible webbing other than wire, and during all closed periods they shall be completely closed by pulling to one side of the pot. In addition, the spillers of all driven traps shall be raised to within 4 feet of the capping and the spillers of floating traps shall be raised to within 4 feet of the surface within 36 hours after the beginning of any seasonal closed period. Within 36 hours after the beginning of any seasonal closed period the tunnels from pots to spillers of all traps shall be entirely disconnected. In respect to traps not provided with spillers, the requirements in regard to spillers shall apply to the pots. In any prescribed fishing area prior to the first date when salmon traps may be operated in any calendar year, no trap or any part thereof, whether under construction or after completion, shall be so arranged or adjusted as to prevent the free and unobstructed passage at all times of all fish.

2. No trap shall have more than two spillers.

3. The use of any so-called hammer-head trap or any modification thereof is prohibited.

4. All trap leads shall be operated in substantially a straight line.

5. No salmon trolling boat shall carry or operate any seine or more than one gill net. The gill net shall be of mesh not more than 2½ inches stretched measure between knots, shall not be of greater than No. 20 gill net thread, and shall not exceed 10 fathoms in length and 100 meshes in depth.

6. The use of any trawl in commercial fishery operations is prohibited: *Provided*, That this prohibition shall not apply to fishing operations conducted solely for the purpose of taking shrimp.

7. The time used in the various areas for the enforcement of the law and the regulations that specify hours and days shall be as follows:

(*a*) In the southeastern Alaska area: Standard time of the one hundred and thirty-fifth meridian of west longitude, which is 1 hour slower than Seattle standard time.

(*b*) In the Bering River, Copper River, Prince William Sound, Resurrection Bay, Cook Inlet, Kodiak, Chignik, Alaska Peninsula, and Bristol Bay areas: Standard time of the one hundred and fiftieth meridian of west longitude, which is 2 hours slower than Seattle standard time.

(*c*) In the Aleutian Islands and Yukon-Kuskokwim areas: Standard time of the one hundred and sixty-fifth meridian of west longitude, which is 3 hours slower than Seattle standard time.

8. All persons engaged in fishery operations are warned to give due regard to all markers erected by the Department of Commerce.

9. In waters where a rack or weir is maintained by the Bureau of Fisheries for the purpose of counting salmon ascending to the spawning grounds, records of the catch of salmon shall be furnished daily by all operators to the local representative of the Bureau of Fisheries in charge, and upon notification by the Commissioner of Fisheries or his authorized representative that an excessive proportion of the run is being taken so that the escapement of any species is less than the 50 per cent specified by section 2 of the act of June 6, 1924, all commercial fishing operations shall at once be discontinued and shall not be resumed until permission therefor is granted by the Commissioner of Fisheries or his duly authorized representative. And if in any year it shall appear that the run of salmon in such waters has diminished there shall be required a correspondingly increased escapement, and upon notification by the Commissioner of Fisheries or his authorized representative all commercial fishery operations shall cease and shall not be resumed until such increased escapement has been secured.

10. The driving of salmon downstream and the causing of salmon to go outside the protected area at the mouth of any salmon stream are expressly prohibited.

11. During the inspection of the salmon fisheries by the agents and representatives of this department they shall have at all times free and unobstructed access to all canneries, salteries, and other fishing establishments and to all hatcheries.

12. All persons, companies, or corporations owning, operating, or using any stake net, set net, trap net, pound net, or fish wheel for taking salmon or other fishes shall cause to be placed in a conspicuous place on said trap net, pound net, stake net, set net, or fish wheel the name of the person, company, or corporation owning, operating, or using same, together with a distinctive number, letter, or name which shall identify each particular stake net, set net, trap net, pound net, or fish wheel, said lettering and numbering to consist of black figures and etters, not less than 6 inches in length, painted on white ground.

13. If in the process of curing salmon bellies the remaining edible portion of the fish is not used, such action will be regarded as wanton waste within the meaning of section 8 of the act of June 26, 1906, and those who engage in this practice will be reported for prosecution as provided for in the act.

14. The taking of salmon for fox feed shall be considered as commercial fishing and subject to all of the limitations in respect thereto.

15. Any increase in the amount of fishing gear employed or any expansion of fishery operations in any district in any season shall, in the discretion of the Secretary of Commerce, result in the immediate imposition of such additional restrictions as may appear necessary.

16. These regulations shall be subject to such change or revision by the Secretary of Commerce as may appear advisable from time to time. They shall be in full force and effect immediately from and after January 1, 1930.

AFOGNAK RESERVE

When fishery regulations effective January 1, 1929, were issued the Afognak Reservation was incorporated with the Kodiak area, and commercial fishing therein was made subject to the general regulations and to those specifically applicable to Afognak waters. These regulations are printed elsewhere in this document.

ANNETTE ISLAND FISHERY RESERVE

The Annette Island Packing Co. again operated in the Annette Island Fishery Reserve under its lease from the Department of the Interior.

In 1929 the company operated six traps within the reservation, the catch of which totaled 445,993 salmon, and 14,678 salmon taken in purse seines were purchased from the natives. In addition, 90,938 salmon taken outside of the reserve—part of which were taken in a trap owned by the company and the remainder purchased from independent operators of traps, seines, and gill nets—were packed at the cannery. In the operation of the plant and the fish traps employment was given to 32 whites, 187 natives, and 1 Chinese.

ALASKA FISHERY INTELLIGENCE SERVICE

As has been the practice for several years, the bureau continued to report by telegraph to the important points in southeastern and central Alaska the prices of fresh fish (chiefly halibut) at Ketchikan. During the closed season on halibut the service was discontinued, as the quantities of other fish sold during that period are negligible.

STREAM IMPROVEMENT

The work of removing obstructions that prevent or impede the ascent of salmon to the spawning grounds has been given considerable attention each year, and in 1929 it received a further impetus through the cooperation of the Territorial Legislature in appropriating $40,000 to be expended in clearing streams and in destroying predatory enemies of salmon. The importance of securing adequate seeding of all spawning grounds and of protecting the eggs and fry from destruction in order that a maximum return may be assured is obvious. To avoid the possibility of damaging the spawning beds the removal of stream barriers is done only under competent direction.

Log jams and other débris were removed from 35 salmon streams in southeastern Alaska during the year. In August a passage 10 feet wide was made through the dam of the Kasaan Gold Co. on Harris River. For several years this dam has more or less blocked the passage of the fish to the spawning grounds, as the fish ladder was not effective except during periods of very high water, which usually occur at times when no fish are running.

In streams tributary to Izhut and Seal Bays on Afognak Island where waterfalls were impassable to salmon the rocks were blasted by dynamite, after which the fish began to ascend immediately. Part of the work in the Cook Inlet area consisted of keeping open coastal streams that became blocked with gravel washed up by the heavy surf. Various other stream improvements were made in the fall by bureau employees when checking up escapements in the

FIGURE 1.—Typical log jam for removal from creek to enable passage of salmon, southeast Alaska

several districts, and plans were outlined for additional work to be undertaken in the early spring.

STREAM MARKING

Virtually all of the salmon streams in Alaska have been marked to show the limits of waters closed to commercial fishing, but attention is given each year, particularly in the spring, to the repair and replacement of markers that have been defaced or destroyed. New markers are erected and changes in location of old ones are made from time to time in accordance with changes in the regulations respecting closed areas.

STREAM GUARDS

The bureau employed 216 men in 1929 as stream guards and special workmen in connection with law-enforcement duties. Of these, 106 were stationed in southeastern Alaska, 71 in central, and

39 in western Alaska. Some of the temporary workers were engaged for only a few days, but the period of employment of the stream guards generally ranged from two to five months.

In southeastern Alaska, 49 stream watchmen furnished their own launches and were assigned to patrol larger bodies of water or in the vicinity of several streams.

In central Alaska, 18 guards were stationed in the Seward-Katalla district, 6 on Cook Inlet, 31 in the Kodiak-Afognak district, 5 at Chignik, and 11 in the Ikatan-Shumagin district. Fourteen of these guards, most of whom were in the Seward-Katalla district, provided their own launches.

In western Alaska 37 were on Bristol Bay; and 2, of whom 1 furnished his own boat, were in the Yukon-Kuskokwim district.

There were also 8 special employees engaged in scientific work—2 on herring and 6 on salmon investigations, this work being conducted chiefly in southeastern and central Alaska.

In addition, there were 12 statutory employees, 45 men on the bureau's vessels, and 17 on the 10 chartered boats.

The foregoing makes a grand total of 298 persons identified with fishery-protective work in Alaska in 1929, as compared with 280 in 1928.

VESSEL PATROL

Fourteen vessels owned by the bureau were operated in fishery-patrol work in Alaska in 1929. Of these, the *Widgeon*, *Murre*, *Auklet*, and *Petrel* were used in southeastern Alaska; the *Blue Wing* and *Red Wing* at Kodiak and Afognak Islands; the *Ibis* at Chignik; the *Merganser* in the Ikatan-Shumagin region; and the *Coot* on the Yukon River. The *Brant* was in the southeastern district during much of the season, being used chiefly in general supervisory work, in which connection one cruise was made westward as far as Unalaska in July. Vessels used in southeastern Alaska for a few weeks in the fall after their return from duty to the westward were the *Scoter*, which had been in the Bristol Bay section until the last of August; the *Crane*, which in May transported bureau employees and supplies to Bristol Bay and later was engaged in patrol work in the Alaska Peninsula district; the *Teal*, which was on Cook Inlet during the salmon-fishing season there; and the *Kittiwake*, which was operated in the Seward-Katalla district until the end of August.

The *Coot* is a new vessel in the bureau's Alaska service, having been built at Bellingham, Wash., in the spring of 1929. It is 50 feet in length and 11 feet in breadth, and is equipped with a 100-horsepower gas engine. It has sleeping accommodations for 7 persons. The *Coot* was shipped north in June on the freight steamer *Derblay* to St. Michael, Alaska, where it was immediately put in patrol service, replacing the *Tern*, which was then sold.

Incidentally to its patrol work during a trip down the Yukon River in August, the *Coot* conveyed Dr. Ales Hrdlicka, curator of the division of physical anthropology of the Smithsonian Institution, Washington, D. C., who was making investigations in Alaska in connection with his study of the American Indian.

The following chartered boats were used in fisheries patrol: *Valkyrie*, *Bear*, *Helen Hinton*, *Janie K*, *Lady Luck*, and *Yukon* in southeastern Alaska; *Pilot* and *Prospector* on Copper River and Prince William Sound; *Coyote* on Cook Inlet; and *Auk* in the Port Moller region.

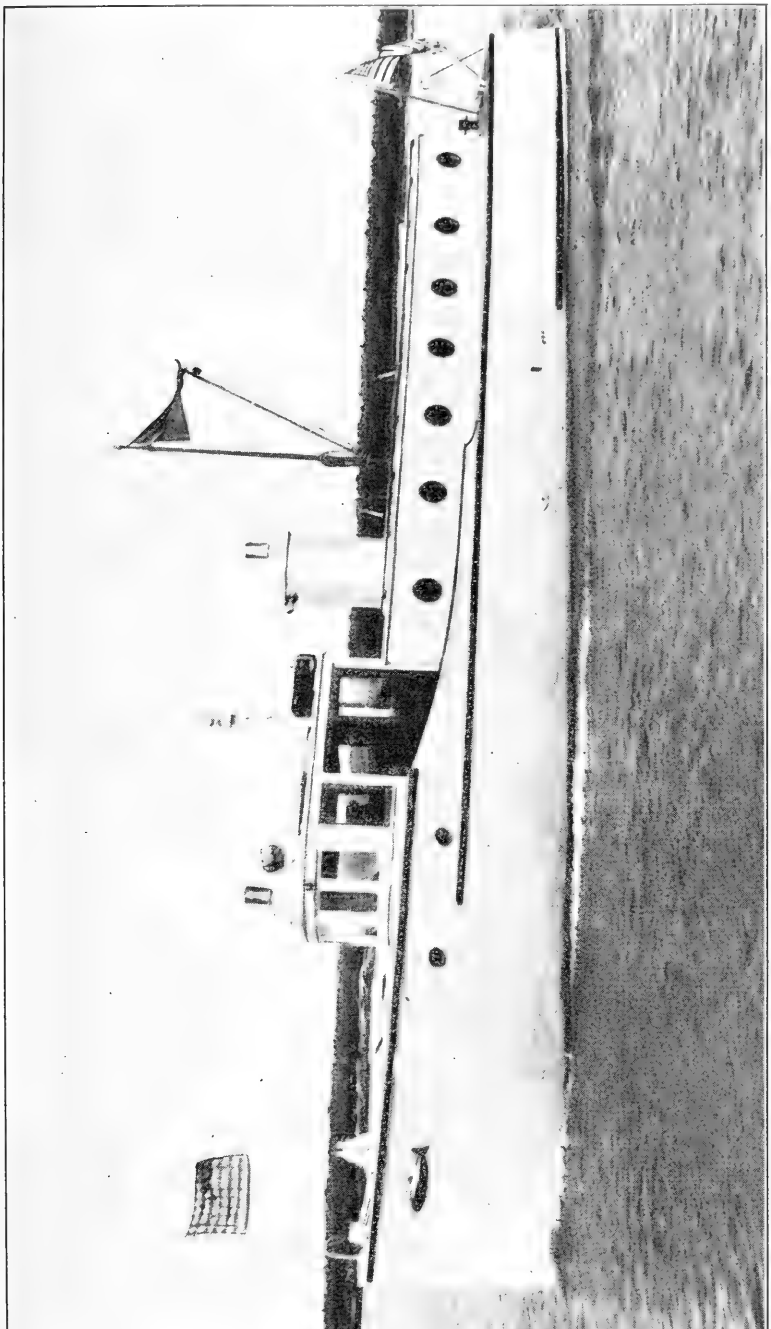

FIGURE 2.—Bureau of Fisheries patrol vessel *Coot*, Yukon River, Alaska

In addition to the foregoing the *Highway*, through the courtesy of the Bureau of Public Roads, was used in the patrol service in southeast Alaska for a part of the month of July, when the *Widgeon* was out of commission awaiting the arrival of new engine parts.

The *Widgeon* sustained some minor injuries to propeller and rudder on October 12, 1929, when she ran on the south end of Russian Reef, off Whitewater Bay, where she remained stranded for about an hour, until the receding tide caused the bow to become sufficiently lowered to permit the boat to slide from the sloping ledge. Two power boats came to the vessel's assistance, and subsequently their owners entered salvage claims against the Government. The matter was referred to the Department of Justice for attention.

AERIAL PATROL

The use of aircraft as an auxiliary patrol for the protection of the fisheries of Alaska was introduced in 1929, a contract having been entered into with a commercial company for the service of a seaplane for a limited number of flying hours. Although but few flights were made, they served to demonstrate the efficiency of this method of patrol on the long, irregular coast of Alaska, with its numerous channels, bays, and inlets, where journeys by boat are necessarily slow and circuitous. Air transportation not only makes possible the survey of a number of streams in a very short time but serves as a deterrent to illegal fishing operations for the reason that operators so engaged have not sufficient warning of the approach of the plane to permit removal or adjustment of their fishing gear in time to escape detection. The patrol in 1929 was confined to the southeastern district, where several trips were made from Juneau and Ketchikan by agents of the bureau, the flights occurring chiefly during weekly closed periods between Saturday afternoon and the following Monday forenoon.

COMPLAINTS AND PROSECUTIONS

Twelve traps in southeastern Alaska were seized in 1929 for illegal fishing. In every case the defendants pleaded guilty before the local commissioners and fines were imposed, upon payment of which the traps were released. Two traps of the Far North Fisheries (Inc.) had the tunnel from heart to pot constructed of wire instead of web as required by the regulations, and five traps of the Demmert Packing Co. were similarly constructed, having also an apron of seine web that did not entirely prevent entrance of fish into the trap during the weekly closed period. The former company was fined $100 for each trap and the latter $200 each. A trap of the Fidalgo Island Packing Co. on the west coast of Revillagigedo Island and one at Narrow Point owned by Jenkins & Coulter were found fishing during a weekly closed period, and fines of $750 and $500, respectively, were imposed. Fines of $350 each were assessed in the case of two traps operated by the Nakat Packing Corporation and one by the Petersburg Packing Co. for having the tunnel open during a weekly closed period in violation of section 5 of the act of June 6, 1924.

In southeastern Alaska, also, 15 boats were seized for fishing in closed areas. On trial before the local commissioners the defendants pleaded guilty and were sentenced to fine or imprisonment. Fines of $250 each were imposed on the owners of the *U & I* and the *Star Lite* and $200 on the owner of the *Zlarin* for fishing in Little Port Walter. Five fishermen operating gill net boats *T88*, *T2319*, and *T391* in closed waters of Chilkat Inlet were fined $35 each. The owner of the seine boat *Katie* was fined $150 for fishing in the north arm of Tebenkof Bay. Six men, who fished with the seine boat *Sykes* inside markers at Chickamin River, were fined $50 each. Fines of $250 each were assessed in connection with illegal fishing by the seine boats *North Star* and *Lincoln* near the mouth of the stream entering Saltery Cove in Skowl Arm. The seine boat *Billie M* was seized on October 1 for fishing inside the markers at Dolomi Bay. A fine of $250 was imposed upon the crew, but as they were unable to raise the money they were sentenced to jail, the master for 25 days and the other three members of the crew for 13 days each.

The power boat *Per Gynt*, owned and operated by the Alaska Pacific Salmon Corporation, was seized for fishing within the closed area of Nutkwa Inlet and during a weekly closed period. A fine of $400 was imposed on the company and $200 each on the 5 members of the crew, 4 of whom were unable to raise the amount and served a jail sentence of 100 days at Ketchikan. The seine boat *Dixie* was seized for fishing within the closed area of Saltery Creek and the master was fined $300. The seine boat *Colletta* was seized for fishing inside stream markers in the south arm of Cholmondeley Sound on October 4, and a fine of $250 was imposed on the master, upon payment of which the boat was released. Inasmuch as it has subsequently been shown that the stream so marked is not a salmon stream, recommendation has been made that the fine be remitted. The master of the herring seine boat *Pronto* was fined $200 for fishing near Eagle Harbor, Lynn Canal.

Other violations in southeastern Alaska during the season were as follows: Masters of the seine boats *T. A. Hinote* and *Dorothy D* were arrested for setting seines within 100 yards of seines previously set and were fined $150 each. Three Metlakatlans, the crew of the seine boat *Claire*, were arrested for fishing during a closed season to supply halibut boats with fresh salmon for bait and were fined $300, $200, and $100, respectively. The owner of the trolling boat *R & B* was fined $200 for fishing in a weekly closed period. A fine of $150 was imposed on a fisherman for using a gill net of more than 150 fathoms in Taku Inlet, and two men operating the trolling boat *T724* were fined $37.50 each for having on board a gill net of 6-inch mesh and in excess of the maximum length permitted on trolling boats. Three seine boats—*Kitty*, *Robert Barron*, and *Star Lite*—were found fishing on October 12 in the south arm of Hood Bay with seines less than 150 fathoms each. The owner of the *Kitty* was sentenced to serve 15 days in jail, the owner of the *Robert Barron* paid a fine of $150, and in the case of the *Star Lite* condemnation proceedings were postponed until the following spring, inasmuch as an accident to the bureau's vessel *Widgeon* prevented towing the boat to Juneau.

The boat *T992* was seized on October 1 for fishing with seine during a closed season and the master was fined $250. Complaint was filed against the operator of a seine which was stretched completely across the head of Cascade Inlet to impound herring, thus preventing the free passage of herring in and out of the inlet. The defendant entered a plea of guilty and was fined $500, the impounded herring were released, and the seine was removed. A seine skiff and seine were seized in the creek at the head of Fools Inlet, evidence indicating that they had been engaged in illegal fishing. Neither the operator nor the owner was apprehended, and the gear with writ of seizure was turned over to the United States marshal at Wrangell.

Cases against the Sebastian Stuart Fish Co., of Tyee; Sam Morris and the New England Fish Co., of Juneau; and E. B. Dudden, superintendent of the Douglas Island Packing Co., in connection with the mild curing and canning of iced salmon more than 48 hours dead, which were still pending at the close of 1928, were dropped, inasmuch as the amendment to the fisheries law under date of February 28, 1929, recognizes the processes of preserving salmon by icing and freezing.

In the Seward-Katalla district a case was brought before the district court against the Copper River Packing Co. and a trap watchman for failure to comply with regulations in respect to the closing of the tunnel from heart to pot of a trap on the east shore of Chenega Island during a weekly closed period. The defendants pleaded guilty and were fined $325 and $75, upon payment of which the trap was released. Three men were arrested on September 5 for fishing near the head of the east arm of Simpson Bay during the closed season. On trial in the commissioner's court the defendants pleaded guilty and were fined $50 each and costs, or imprisonment at not to exceed one day for each $2 of said fine. All spent two days in jail, and then the fines were paid. The salmon which they had taken illegally were seized and sold for $35.75. A case was brought before the commissioner's court charging a fisherman on the Copper River Flats with failure to tie up a stake net sufficiently to prevent its fishing during the closed season. The defendant pleaded guilty and paid a fine of $50 and costs. Several gill nets set for fishing during closed periods on Copper River Flats and in Orca Bay were seized and are being held for disposal by the Department of Justice, inasmuch as the owners were not apprehended. Salmon taken in these nets were sold for $27.80. The proceeds of all sales of salmon were turned over to the district attorney.

In the Kodiak district two men were arrested for illegal fishing in Uganik Bay during a weekly closed period and were taken before the United States commissioner at Kodiak, where they pleaded guilty and were fined $250 each. The proceeds of the sale of a small number of seized salmon were turned over to the commissioner.

In the Kvichak-Naknek district of Bristol Bay 19 cases were tried before the local commissioner—12 of which involved fishing in closed areas, 3 fishing in closed periods, 3 the use of gill nets in excess of 150 fathoms, and 1 the use of a gill net of 5-inch mesh. Three cases (2 in connection with fishing in closed areas and 1 fishing in a closed period) were dismissed, and in the others fines ranging from $25 to $150 and totaling $1,640 were imposed on 32 defendants.

TERRITORIAL FISHERY LEGISLATION

The Legislature of Alaska at its biennial session in 1929 passed six bills affecting the fisheries of Alaska.

Three of these authorized and made appropriation for the refund of specified sums of money paid as licenses for fish traps, either because the operation of the traps was prohibited by governmental regulation after the licenses had been issued or because of overpayment for certain licenses in 1927—an act of the legislature that year having reduced the license charge on hand-driven beach traps from $200 to $50.

A further act authorized the Territorial treasurer to make refund of money paid as licenses for fish traps in certain cases where the driving or operating of such traps is thereafter prevented by reason of governmental regulations.

On May 2, 1929, an act was passed appropriating $40,000 to be expended in cleaning streams and for the destruction of predatory enemies of salmon under the direction of the Governor of Alaska in cooperation with the Bureau of Fisheries.

Another act amended the act of 1923 as amended in 1925, in regard to licensing fishermen, and made operative the following license fees:

Resident fishermen of all classes	$1
Nonresident fishermen who use hook and line in trolling	250
Nonresident fishermen who use gill nets	10
Nonresident fishermen who use seines	25

Under this act, also, the term "resident" fisherman was defined to mean one who at the time of applying for a license shall have been a bona fide resident of the Territory of Alaska for at last one year, instead of six months as formerly.

TERRITORIAL LICENSE TAX

Fisheries license taxes were collected by the Territory under the general revenue law of 1921, as amended in 1923, 1925, and 1927. A statement from W. G. Smith, Territorial treasurer, under date of April 12, 1930, gives the collections made to that date for the year 1929. It was stated that collections under the several schedules were fairly complete with the exception of pack taxes due from a few of the smaller canneries, salteries, and fish-oil and fish-meal plants. Approximately $11,000 was still to be collected on the pack of canned salmon and about $5,000 on fish oil and fertilizer, while $8,990 was due under the whale-oil and fertilizer schedule.

Fishery license taxes collected by Territory for fiscal year ended December 31, 1929

Schedule	Division No. 1	Division No. 2	Division No. 3	Total
Salmon canneries (pack)	$110, 266. 25		$306, 711. 96	$416, 978. 21
Clam canneries	1. 77		403. 74	405. 51
Salteries	1, 854. 09	$93. 54	1, 159. 81	3, 107. 44
Cold-storage plants	1, 660. 00		520. 00	2. 180. 00
Fresh-fish dealers	3, 668. 91		3. 08	3, 671. 99
Fish-oil works and fertilizer and fish-meal plants	25, 071. 42		1, 197. 41	26, 268. 83
Fish traps	92, 005. 77		60, 367. 58	152, 373. 35
Gill nets	605. 00	36. 00	4, 107. 50	4, 748. 50
Seines	6, 660. 00		2, 740. 00	9, 400. 00
Total	241, 793. 21	129. 54	377, 211. 08	619, 133. 83
Salmon canneries (net income), not possible of segregation as to judicial division				34, 173. 30
Total collections				653, 307. 13

BRISTOL BAY DISTRICT

Operations in the Bristol Bay region in 1929 consisted primarily of the enforcement of the Alaska fishery laws and regulations, observation of the salmon runs and escapement to the spawning grounds, construction and operation of salmon-counting weirs, and the improvement of quarters for bureau employees at the marine ways at Naknek. The work was organized by Agent Dennis Winn and was under his personal supervision during the season.

In May the bureau's patrol vessel *Scoter*, which had been extensively remodeled and put in first-class condition, sailed from Seattle for Bristol Bay with Warden N. O. Hardy and five special employees, besides the crew. Twelve special employees were transported on the bureau's vessel *Crane*, 10 on a regular passenger steamer, and 4, in addition to Agent Dennis Winn, on vessels of the Pacific American Fisheries and Libby, McNeill & Libby. These, together with two laborers and a carpenter employed locally, a workman transferred from the crew of the *Crane*, and two employees who had remained in the district over the preceding winter, comprised the Bristol Bay force for the 1929 season. All food supplies and some of the equipment were transported by the bureau's vessels, while the larger shipments, including lumber, gasoline, skiffs, a pot scow, and pile driver, were taken north on cannery freighters and transferred to the Naknek River from the ship anchorage.

At the end of the season, return passage was obtained on a regular transportation steamer for 13 men, 1 of whom joined the crew of the *Crane* at False Pass, 11 were transported to the States on the *Crane*, and 6 on the *Scoter*, 4 remained in the district over winter, while Agent Dennis Winn and Warden Hardy crossed the portage to Iliamna Bay, where they took passage on the bureau's vessel *Teal* to Anchorage, proceeding thence by regular transportation lines to Juneau.

Necessary repairs of the bureau's launches, scows, and equipment occupied all hands from May 23 to 29. Construction of the weirs (whose operations are covered in another section of this report) was then started, which work was greatly facilitated by the use of the new pile driver. Prior to the opening of the red salmon season at 6 a. m. June 25, all arrangements were made for patrol of the commercial fishing grounds.

Mr. Hardy's report on operations during the season is as follows:

GENERAL REPORT OF SEASON'S OPERATIONS

PATROL

The patrol vessel *Scoter*, 6 launches, and a skiff were used in the patrol of the waters of Bristol Bay during the fishing season of 1929. Nineteen cases of violation of the Alaska fisheries laws and regulations were reported and tried before the local United States commissioner. The patrol fleet was assigned to the various sections of Bristol Bay, as follows:

Ugashik River and Bay.—Launch *No. 6*, C. M. Hatton and Oscar Thorene.

Egegik River.—Launch *No. 5*, Arthur Satterwhite and Clinton Gross.

Naknek River.—Launch *No. 2*, Leslie L. Rice and Ray O. Nichols.

Kvichak Bay and River.—Launch *No. 1*, Elmer Quistorff and Ray H. Nichols.

Nushagak Bay and River.—Launch *No. 3*, Eric Fenno.

Igushik River.—John E. Van Ogle with a skiff.

The *Scoter* was used in general supervision of the bureau's activities and launch *No. 7* was engaged in connection with weir operations, as well as in patrol of the Kvichak-Naknek area.

Data were collected in regard to fishing operations and the runs of salmon in the several rivers. In all, 913 fishing boats were operated by the canneries and 160 by independent fishermen, local whites, and natives, who sold the catches to the canneries. Of the independent boats, 35 were used by white residents and 125 by natives, as compared with 30 used by whites and 88 by natives in 1928. The number of commercial stake nets operated increased from 104 in 1928 to 139 in 1929.

RUNS AND ESCAPEMENT OF SALMON

While the pack in the Bristol Bay district compared favorably with the average production, the run was not proportionately abundant. Weather conditions, although rough on occasions, were favorable to the fishermen throughout the season, and little or no loss of time because of inclement weather was experienced while good numbers of fish were in the bay. Moreover, the fish were of unusually large size—the largest in the history of the industry, according to canners operating in the district for many years.

Kvichak-Naknek Rivers.—The runs of salmon were spasmodic, but never heavy. The early season pack was larger than in the previous year and there were prospects of a big season. On July 4 a good run set in along the west shore at the Gravel Spit, and excellent catches were made by the fishermen on the flood tides of July 4 and 5. During the following week small numbers were taken, but a good run set in on July 12 and continued over the weekly closed period to July 16, after which small catches were made to the end of the season. There were but two good periods of run, each of short duration. Escapements over the weekly closed periods were good but not adequate for efficient seeding of the vast spawning areas in these river systems.

Egegik River.—Set nets operated by Indians showed good small runs before the opening and at the beginning of the commercial fishing season, which continued until June 29, when they diminished to negligible numbers. A heavy run set in on July 12, but inclement weather at that time assisted the escapement, as very few fishermen were out. On July 16 the run dropped off to fair numbers, which condition prevailed to the end of the season. While the escapement was not on a par with that of several previous years, it was considered fair in comparison with the run and the commercial catch, but not sufficient for the available spawning area.

Ugashik River.—The run into the Ugashik River was negligible until June 25, when a few fishermen made small catches. It increased slowly, a few fish per boat being taken each day until July 2, when boats averaged about 400 fish each. The catch then declined to small numbers until July 12, when a fair run set in and fishermen who braved rough weather averaged 900 to 1,000 fish per boat. After that date a rapid decline occurred and there were negligible numbers at the end of the commercial season. At no time were there fish in encouraging numbers. The count of salmon at the Ugashik weir shows a steady falling off each year, the escapement in 1929 being less than one-fifth that of 1926.

Nushagak River.—The red salmon run came in early, the fish making their first appearance in good numbers on June 28, and the run continued strong over the weekly closed period and through July 8. Then followed two days of light run. A second heavy run developed on the 11th and continued through the 14th, after which it tapered off to light numbers. Although not as heavy as in 1928, the run and escapement at Nushagak were good, comparing favorably with other good years. Heavy runs during the weekly closed periods insured a proportionately large escapement.

DESTRUCTION OF PREDATORY FISHES

As in the previous season, a bounty of 5 cents was offered for every predatory trout taken in the Bristol Bay district, payment thereof in the current year being made from the special appropriation by the Territorial legislature for improving conditions of the salmon spawning grounds. The natives catch the trout, dry the tails, assemble them by the hundred on strings, and deliver them to a representative of the bureau, who prepares an affidavit on the form provided by the Territorial Government. Arrangements have been made whereby the owners of various trading posts will accept these trout tails as cash for purchases made by the natives. The promptness with which payment can thus be effected is a further incentive to the capture of trout by the natives.

INSPECTION OF ILIAMNA AND LAKE CLARK SPAWNING AREAS IN 1929

The following report was made by Agent Dennis Winn covering his trip of inspection during the month of August:

After the close of the commercial fishing season in Bristol Bay and the completion of arrangements for the return of bureau employees to the States, the writer and Warden N. O. Hardy left Naknek in patrol boat *No. 7*, with patrol boat *No. 6* in tow, to inspect the salmon spawning areas of Iliamna Lake, as in previous years.[2]

Departure from Naknek was made on the early morning flood tide on August 11, and Koggiung was reached on the ebb tide, where it was necessary to await the next flood before proceeding up the river. On the evening flood the journey was continued as far as the lower end of Horse Shoe Bend, where the boat was anchored overnight, again proceeding up river the following morning.

The customary fish village of native reindeer herders was established on the banks of the Kvichak River near the lake outlet. During a previous visit to this village on July 9 the writer noted a continual passage of salmon upstream on both sides of the river for almost its entire length. At that time the natives had about all the fish they needed and were enthusiastic over the heavy run. The population of this village is increasing slowly each year, and a white man is establishing a small trading post here. The permanent winter quarters of the natives are back on the tundra about 3 miles, to which place their fish are transported as soon as cured. The natives had no idea as to the number of salmon cured, but an estimate of their requirements would place the number between 8,000 and 10,000.

Belinda Creek was reached that afternoon and was inspected for a distance of about 3½ miles. The fish village, comprising several smoke houses, caches, etc., which was formerly situated at the stream mouth was completely destroyed by early spring floods. All of the structures with the exception of one cache were washed away, and the stream mouth had moved down the lake shore about 150 feet. The natives who formerly lived here have established a fish village about 5 miles below the creek and are fishing along the lake shore at a location called "Gravel Spit." Belinda Creek has small possibilities, and in previous years almost the entire run of salmon has been taken by the natives for food. At the time of the examination this season, however, about 6,000 red salmon were spawning in the stream, mostly in the first mile; above that there are but few good spawning areas, the upper reaches of the stream being composed of large bowlders and hard bottom with swift water.

In the evening the boat was brought to the anchorage at Big Mountain. Early the following morning departure was made for Kokhonak Creek. Several extremely large schools of salmon, comprising many thousands of fish, were noted in and around the mouth of the creek. Although good schools were seen for a considerable distance upstream, they became fewer and smaller as the ascent continued. The fish were beginning to scatter over the spawning beds, but in comparison to the number seen in the stream only a few had spawned. Near the head of the stream where it issues from the lake the water was considerably lower and fewer fish were noted than in former years. In the spring creeks entering the lower end of the lake there were less than half the number of salmon seen in the preceding year.

As careful a check as possible was made of the main stream and the spring creeks, and it was estimated that about 50,000 salmon had passed above the native village which is situated near the mouth of Kokhonak Creek. The salmon were not as numerous as they were last year above the village, nor were as many seen in and around the stream mouth, where approximately 75,000 were observed this season schooling and beginning to ascend, making a total estimate of 125,000 for the entire stream. This number undoubtedly will be increased by late arrivals, as it appears from all the information gathered that the salmon are entering the streams later each year to spawn. Four families, composed of 21 people, at the fish village were curing salmon for personal use and dog feed. These natives are reindeer herders, having the animals in the vicinity of their camps. They are establishing a permanent village on the lake shore about 3 miles east of Kokhonak Creek, where two traders are contemplating opening trading posts. Their caches and racks appeared to contain about 7,000 cured salmon, and they can secure easily with hook or a couple of fathoms of web any additional fish needed.

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[2] The salmon referred to in this report are red salmon, and the natives are Indians.

The course was then directed to Copper River, examination of which was begun on the morning of August 14 in a small skiff with outboard motor. Unfortunately the motor was put out of commission on the riffles about 2 miles upstream, and it was necessary to row and line the skiff the remainder of the distance inspected. Good schools of salmon were noted in the lower mile of the river and at every advantageous point along its course. The stream was ascended for about 5 miles, and all indications were very favorable. The fish here, as at Kokhonak Creek, appeared late in spawning preparations. While the escapement was on a par with only a fair year and was deemed not entirely adequate for the spawning area, it is felt that the seeding in this stream, as well as in Kokhonak, will be almost equal to the capacity of the beds. A close estimate was impossible because of water discoloration, but from observations and comparisons with other years it is estimated that about 150,000 salmon were in the stream.

On August 15 a small unnamed stream at the head of Intricate Bay was inspected. This stream is the outlet for a lake about a mile or more in diameter, and its current is very sluggish. No fish were noted in the stream nor in the

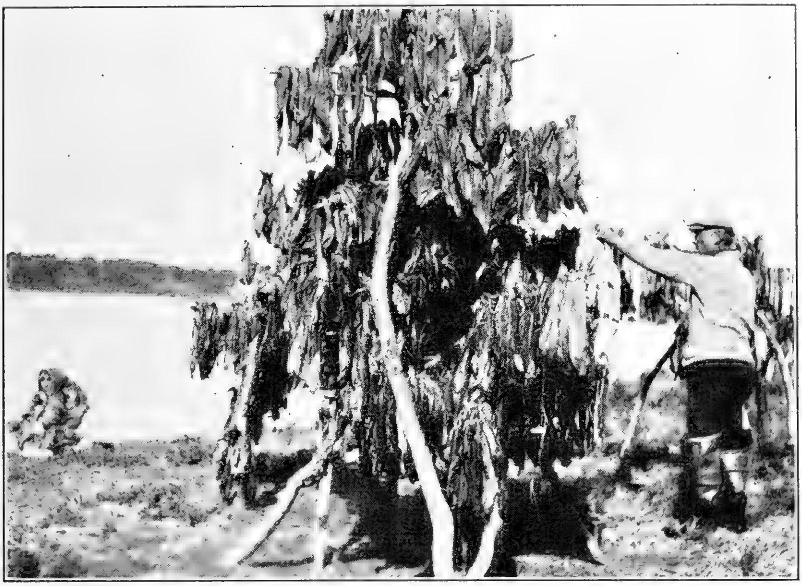

FIGURE 3.—Natives curing salmon for their own use, western Alaska

vicinity of the lake outlet. A trip was made up a small tributary to the lake creek—a stream about 30 feet wide and 1 foot deep with medium flow—where a fair escapement was noted. About a mile upstream a perpendicular wall approximately 12 feet high was encountered, over which no fish could pass. It was estimated that about 2,000 salmon were in the stream in the last stages of spawning, which condition was unlike that prevailing in other areas visited to date.

The journey was continued to Iliamna Village, where arrangements were made to have patrol boat *No. 7* return to Naknek, further examination of the spawning areas to be carried on with patrol boat *No. 6*. Early in the morning of August 16 the inspection of streams along the north shore of the lake was begun. Streams in Pedro Bay. Knutson Bay, and Chekok Bay, as well as other streams heretofore harboring spawning salmon, were visited, and all except Newhalen River and the vicinity of Roadhouse Portage were almost complete failures. People living near the poorer streams were preparing to go elsewhere for their winter supply for home use and dog feed.

On August 17 the lower reaches of Newhalen River were inspected, in the vicinity of which are numerous fish villages. Here it was learned that a very heavy run had extended over the entire season, and at the time of the visit fish were being taken in fair numbers by various families camped along both shores of the river for about 1 mile above its outlet into Lake Iliamna. Most of the natives had discontinued fishing, as they had a sufficient supply for their winter use. About a dozen native families were located here, and from the appearance of their caches and smoke houses, it was judged they had from 20,000 to 25,000 salmon cured or in the course of curing. The river was badly discolored from glacier water, so that no intelligent estimate was possible, and it was necessary to rely on information received from the people who operate here each year for comparison of the run with that of former years. They claim that the number of salmon this year was from two to five times that of last year at this point.

No trip was made into Lake Clark, as previous experience indicates that nothing can be gained from such a trip at this time of the year, because fish do not reach the upper lake waters until very late and the waters in the lower reaches are too discolored for effective observation.

On August 20 a trip was made up the Iliamna River for about 12 miles from its mouth. This stream, like all others along the north shore except Newhalen River, was practically a failure up to this time, and future possibilities appeared meager. However, local residents advised that long after the inspection last year an enormous run of salmon entered this stream and that live salmon were seen there in January. They stated it was the first time that such a run had occurred and that the water in the river was unfit for home use until after the spring floods. There was no indication on the date of inspection this season of any number of salmon in the lake in the vicinity of this stream or along the north shore east of Roadhouse Portage, and no late run is anticipated. However, a representative of the bureau stationed here through the winter will report any late runs or unusual occurrences through the fall and winter months in those streams along the north shore which now have a negligible escapement.

Summarizing the escapement over the entire district, it is considered almost a duplicate of that of 1924, when a fair escapement was reported. Localities where the salmon were numerous were the same as in that year, with possibly a heavier run this year into Newhalen River and thence to the Lake Clark district.

KUSKOKWIM RIVER

From the latter part of May until the first of September, Stream Guard Charles McGonagall was again stationed on the Kuskokwim River with a chartered launch to observe fishing operations, which are carried on to supply local needs and not for export.

Unusually good runs of salmon, especially reds and chums, ascended the river, and weather conditions were favorable for curing and drying fish for dog feed. The first catch of kings was made on May 27. The run of this species continued through June, decreasing toward the end of the month, and it was entirely over by July 10. The run of reds and chums began on June 17, continuing strong until August 10. The natives claimed they had never seen better runs, and they put up an ample supply to carry them through the winter. During the last few years the catch of furs in this region has been good and the prices high, and therefore the natives have not been much interested in catching many fish. The regular airplane service along the Kuskokwim has pratically ruined the local dried-fish market.

Two white fishermen and 354 natives were engaged in the fishery in 1929, using 345 gill nets of 4,100 fathoms, 20 fish wheels, and a number of small boats. The products consisted of 7 barrels of pickled kings and 364 tons of dried chum salmon for dog feed.

YUKON RIVER

Fishing in Yukon River for export from Alaska is prohibited, but operations were carried on as usual for local requirements and to supply the market for dried salmon throughout the interior of Alaska. Inspector C. F. Townsend and one stream guard were on duty at the fishing grounds throughout the season.

The run of kings started on May 31, continued through June, and was virtually over by July 10. The main run of chums started on June 20 and lasted through July, while the late run began about September 1. Fewer beluga whales were seen by Inspector Townsend at the mouth of the river this season than ever before. Ordinarily they follow the salmon runs into the river in great numbers, causing considerable damage to fishing nets and wheels.

Products of the Yukon and Tanana fisheries were as follows: 200 cases of kings and 4 cases of chums canned; 21 barrels of kings, 38 barrels of chums, and 3 barrels of cohos pickled; 3,216 pounds of beleke from kings; 1,800 pounds of kippered kings, and 699,000 pounds of chums, and 1,600 pounds of kings dried. Apparatus consisted of 226 wheels, 75 gill nets of 655 fathoms, 2 power vessels, 1 launch, 9 gill-net boats, and miscellaneous small boats. There were 19 whites and 294 natives engaged in the fishery.

WEIRS FOR COUNTING SALMON ESCAPEMENT

In connection with scientific investigations to ascertain what relation exists between spawning colonies of varying size and the number of progeny they furnish, weirs are maintained in a number of streams in Alaska for the counting of salmon ascending to the spawning grounds. One of these weirs, that in the Karluk River, has been in operation each season beginning with 1921, the Chignik weir was started in 1922, and others have been installed from time to time since then until in 1929, 20 weirs were maintained in important salmon streams in various districts.

It was planned, also, to operate again the weir at Thin Point Lagoon and to establish a new weir on the Kvichak River. In the former locality, where heavy deposits of sediment have been brought down by the glacial stream, an attempt was made to build a jetty to prevent the impairment of the weir in time of freshets and to insure an adequate depth of water for the ascent of salmon during droughts, but it was unsuccessful. In the Kvichak River large quantities of grass and algæ clogged the wire netting of the weir, causing high water, the force of which undermined the structure before it was completed. Work at these weirs was therefore abandoned for this season, the materials being salvaged and stored.

Reports of operations of the several weirs and of the counts of salmon in 1929 are as follows:

ANAN CREEK

Work on the Anan weir was started on May 7 and the rack was ready for operation on May 21. Steelheads began to ascend on June 7 and the first pink salmon were counted through on June 14, or a few days earlier than in the last two seasons, although no appreciable numbers appeared until June 29. The run held fairly steady through July and reached its peak on August 2, when 10,454 pink salmon were counted, after which the number gradually decreased. The last count was made on September 22, when total escapements of 221,482 pinks, 1,376 cohos, 79 chums, 50 kings, 63 reds, and 128 steelheads were recorded for the season. Walter J. Larson was in charge of operations at this weir.

EAGLE CREEK

The weir at Eagle Creek was installed in June and the first salmon were counted through on July 2, when 53 reds and 9 steelheads ascended. Pink salmon began to appear at the weir on August 12 and the peak of the run was reached on August 27 with an escapement of 12,400. Counting was continued through October 5, and the season's escapement consisted of 102,654 pink salmon, 1,958 reds, 5,066 chums, 1,839 cohos, and 18 steelheads. Work at this weir was carried on by J. A. Kelley.

OLIVE COVE

Installation of the Olive Cove weir was started on June 15, and on the 19th the structure was in readiness for operation. Counting began on July 10 and continued through September 10. At the time the weir was removed, September 11, it was estimated that 1,000 pink salmon were in the river below the weir, which with the number tallied bring the total escapement to 36,372 pink salmon. In addition, 72 cohos and 25 chums were counted. Operations were in charge of Walter Campen.

STANEY CREEK

The counting of salmon ascending Staney Creek was begun in 1929 by the erection of a new weir approximately three-fourths of a mile from the stream mouth, where the average depth of the water is from 10 inches to 3 feet. This region is very flat and the tides reach as far as a half-mile above the weir. Several large pools below the rack supply ample space for the fish before they ascend the stream. The weir is about 150 feet in length, with four counting gates, only two of which were used at a time. Construction was started on June 2 and finished on June 16. A small cabin, 10 by 14 feet, was built for the watchmen, and a trail was blazed along the stream from the weir site to the bay. The first count of salmon was on July 15 and the last on October 4, when a total of 106,518 pink salmon, 11,177 cohos, and 33,180 chums had been tallied. Work at this weir was carried on by J. H. Hall and D. M. Dingwall.

WHALE PASSAGE

A new weir was established on the creek emptying into the northwest arm of Whale Passage at a site approximately 2 miles above the outer extremities of the tide flats. The large tides reach the weir but do not interfere with the work of counting. The first salmon passed through the weir on July 21 and counting was continued through October 5, when the total escapement for the season numbered 191,948 pink salmon, 2,856 cohos, and 5,728 chums. Charles Nelson was in charge of operations at this weir.

SITUK RIVER

A weir for counting the spawning escapement in the Situk River was operated as in the previous year, the structure being completed on June 1. The first salmon were seen below the rack on June 4 and counted through on June 12. Counting was continued until August 11, when very high water submerged and undermined the weir. Efforts to repair the damage were unsuccessful and the structure was removed on August 24. The count of salmon numbered 167,865 reds, 157,633 pinks, 3,559 kings, and 47 cohos. A conservative estimate of the number of red salmon passing upstream after the weir count was discontinued, together with the actual count through August 10, places the total escapement of reds at not less than 200,000. Operations at this weir were under the supervision of Warden Harry A. Pryde.

KARLUK RIVER

In 1929 a counting weir was erected on the Karluk River at about the same location as in previous years. Work was begun on May 3 and completed a week later. The first salmon were counted on

FIGURE 4.—Whale Passage weir established in 1929

May 19, when both kings and reds began to ascend, and counting was continued through October 7. The total escapement during this period was 900,320 reds, 27,051 cohos, 11,584 pinks, and 8,307 kings. A few salmon, principally cohos and steelheads, were still in the lagoon when the weir was removed on October 14.

Because of the poor showing of red salmon commercial fishing in the Karluk region did not start until June 19, and on July 1 fishing by beach seines from Cape Karluk to Cape Uyak was stopped and no fishing was resumed there during the remainder of the season. The entire Karluk area was closed to commercial fishing after August 10. The commercial take of red salmon from the Karluk run was 182,708, indicating that 17 per cent of the total run was caught and 83 per cent escaped to the spawning grounds.

A large run of migrating red salmon fingerlings was noted this season and as usual 50,000 of them were marked. Some 10,800 trout were caught and destroyed.

Ray S. Wood was in charge of counting operations at the Karluk weir under the direction of Warden Howard H. Hungerford.

ALITAK BAY

In addition to the weirs maintained as heretofore on two streams tributary to Olga Bay, a small weir was operated from June 29 to August 18 in Silver Salmon Creek, where considerable numbers of red salmon were noted. The cannery station weir was completed on May 12 and the upper station weir on May 25. Trout traps were established at all weirs and good catches were made during the season. The seaward migration of red salmon fingerlings was much larger than in the past few years.

The first red salmon were counted through the upper station weir on May 30 and through the cannery station weir on May 31. At the latter place the run was unusually light, attributable partly to the low water there and partly to the number of reds that entered Silver Salmon Creek. Counting was continued until the last of September, when the total escapement of red salmon was 332,783, of which 302,508 were counted at the upper station weir, 18,094 at the cannery station, and 12,181 in Silver Salmon Creek. In addition, 15,838 cohos and 2,318 pinks were counted through the weirs. The total reported catch of red salmon in the Alitak district was 200,989.

Henry B. Looff, under the supervision of H. H. Hungerford, was in charge of operations for the bureau.

CHIGNIK RIVER

The Chignik weir was established at approximately the same site as in 1923 and was built on the tripod plan, as heretofore, with four counting gates 22 inches wide and one 76-inch gate for the passage of small boats. Construction was started on April 22 and completed on May 18. While it was in progress Dolly Varden trout were noted going downstream, but they appeared to be fewer in number this season than during any other recent year. The seaward migration of young salmon began on May 15 and continued in good numbers until the latter part of June, after which few descended the river, although schools were seen feeding and loitering in coves along its course. From August 19 to September 29 schools of young salmon were noted going upstream. It is probable they went out to salt water later in the season.

A few red salmon began to ascend to the spawning grounds on June 5, the run gradually increasing until its peak was reached on June 26, the count through the weir on that date being 102,306, while 57,795 were taken commercially. Slightly more than half of the total season's escapement passed through the weir in June, but the run held fairly steady through July and August, gradually falling off after September 1. The counting was continued through October 3, when 1,860,551 reds, 37,752 cohos, and 3,425 kings had been tallied.

The commercial fishing season in the Chignik area is from June 1 to October 1, but stormy weather in May prevented the driving of traps before the opening of the season. Six traps were operated in Chignik Bay and Lagoon by the three companies that have engaged in the industry in this district during previous seasons. Fishing was started on June 13 and was discontinued on September 22, the total reported catch of red salmon from the Chignik run being 1,003,997. The work at Chignik was under the supervision of Warden Charles Petry.

AYAKULIK OR RED RIVER

A new counting weir, 220 feet in length, was established on Ayakulik or Red River in the season of 1929, the site being about one-fourth of a mile above the mouth of the river. The work of installation was started on May 25 and completed on May 31 in time for tallying the first ascending fish. Counting was continued to September 6, when a freshet began bringing down so much grass and sod that it became impossible to maintain the weir, and it was removed on September 16. The total count of salmon for the season consisted of 28,950 reds, 9,085 cohos, 2,990 pinks, and 1,407 kings. At the time the freshet began there were very few red salmon entering the river, but it was estimated there were some 50,000 cohos in the lagoon, and others came in later and passed upstream.

A large migration of red salmon fingerlings began about June 9 and continued until about the middle of July. In the first part of the season a great many Dolly Varden trout were noted coming down the river above the weir. Good catches were made with a seine, the total number of these predatory fish destroyed during the season being 51,817. Hair seals were numerous around the mouth of the river, and many salmon counted through the weir showed scratches and bites made by these animals. A considerable number of lamprey eels were noted spawning in the mouth of the river during the spring.

Henry B. Looff supervised the building of the weir and Fred R. Sondberg had charge of its operation, the work being under the general direction of Warden H. H. Hungerford.

UGANIK RIVER

Additional lumber to replace material lost when floods damaged the Uganik weir in the previous August was taken to the weir site on May 30, and the structure was completed on June 15. Aside from a freshet which delayed this work, the river was at a moderate stage throughout the season and no difficulty was experienced in maintaining the weir. Counting of salmon was begun on June 15 and continued through September 11, when the total count was 24,893 reds, 11,654 chums, 4,973 pinks, and 476 cohos. In all probability several thousand red salmon ascended the river before the weir was ready for operation. It is estimated that about 25 per cent of the chums and upward of 90 per cent of the pinks that entered the river spawned below the rack. H. Olafson, under the direction of H. H. Hungerford, constructed and operated this weir.

KAFLIA BAY

A new weir for the counting of salmon was established at the head of Kaflia Bay in the short stream that issues from the first lake. Work was begun on June 8 with the erection of horses, the placing of stringers, and the making of a gate, and the weir was finished on the following day. At that time the water in the stream was very high, being some 2 feet above the normal summer level. The first red salmon passed through the weir on June 18, and counting was continued through August 24, when a total of 13,670 reds, as well as 286 pink salmon, had been counted.

Migrating red salmon were plentiful from June 18 to July 10, and they seemed to be of two distinct sizes, 2½ to 3 inches and 4 to 5 inches, which schooled separately. In the early part of the season hair seals were rather numerous in the small entrance to the lagoon, and later, when water in the streams was low, many bears came to the outlet of the first lake, where they were particularly destructive of salmon and at times damaged the weir by tearing off pickets.

Peter Magnuson operated the weir under the supervision of H. H. Hungerford.

ENGLISH BAY

A weir was again maintained for counting salmon ascending the stream at the head of English Bay. The salmon run started on June 2 and ended July 26, with a total escapement of 15,407 reds. Counting operations were carried on by Jack Tansy to June 30 and by James Hart for the remainder of the season.

CHINIK CREEK

Construction of the weir at Chinik Creek was begun on June 3 and completed on June 11. Counting started on June 29 and continued through August 3, when the total escapement numbered 30,440 red salmon. Alex Lind was in charge of the work at this place.

KALGIN ISLAND STREAM

No weir is maintained at the salmon stream on Kalgin Island, as the channel is but a few feet across and during daylight tides the stream watchman has no difficulty in making an actual count of salmon ascending the stream. However, only an estimate can be made of the number that enter during the night. The total count of red salmon in the 1929 season was 10,864, and it is estimated that a like number passed upstream on the night tides, making a total escapement of 21,728.

ORZENOI RIVER

A counting weir was operated in 1929 for the first time at Orzenoi River, the site being about one-half mile from the mouth of the stream. Construction began on June 4 and was completed on June 6. A watchman was stationed there on June 28, and the first red salmon were counted through the weir on July 6, while pinks began to ascend on July 23. Counting was continued through August 15, when the total number tallied was 5,740 red salmon and 4,997 pinks. A few reds and a considerable number of pinks were still in the stream at the time counting operations were discontinued. Work at this place was in charge of Assistant Agent L. G. Wingard.

MORZHOVOI BAY

The Morzhovoi weir, on the outlet of the lake at the head of Middle Lagoon, was put in readiness for operation and a watchman was stationed there during the last week of June. The first salmon passed through the weir on July 7, and counting continued through September 5, when the total escapement was 15,974 reds and 45 cohos. Assistant Agent L. G. Wingard directed operations at this weir.

NAKNEK RIVER

The counting of salmon ascending the Naknek River to the spawning grounds was started in 1929 by the establishment of a weir about 26 miles above the marine ways, just below the rapids, where the river is approximately 1,150 feet wide and at high-water stage is from 4 to 10 feet deep. Seven counting gates were provided, each with an opening about 8 inches wide, and one larger gate was built where the channel is deepest to permit the passage of boats through the weir. Construction was begun on June 2 and completed on July 2, the work having been considerably delayed because of heavy wind storms and high water.

A small early run of salmon ascended the river before the counting weir was completed, and there were some fish below the rack after it was submerged on July 31, but the bulk of the run passed upstream in July. It is noted, however, that the early run appears to be gradually increasing, and it was somewhat larger this year than in any previous year. The total count of salmon from July 3 to July 30, both dates inclusive, was made up of 561,916 reds, 1,498 kings, 1,044 chums, and 134 pinks. Wm. E. Sullivan, under the direction of Agent Dennis Winn, was in charge of this weir.

UGASHIK RIVER

Construction of the weir on the Ugashik River was started on June 17 and completed in 10 days. The first salmon passed through on July 1, when 14 reds were counted. The total escapement through August 10 consisted of 147,513 reds, 557 chums, 29 pinks, and 23 kings. It was estimated that there were about 1,500 red salmon in the river below the weir at the time it was removed on August 10. They were not bright fish and presumably would spawn in the stream bed below the rack. No fish were reported in the lower river at that time. Henry McFadden, under the supervision of Agent Dennis Winn, carried on operations at this weir.

SALMON TAGGING

Continuing the series of tagging experiments that have been conducted in Alaska since 1922 to develop information on the migration routes of individual runs of salmon, the bureau tagged approximately 4,000 salmon in central Alaska during the summer of 1929. Of this number, 1,900 were tagged in Cook Inlet and about 2,100 in Prince William Sound.

The Cook Inlet operations consisted of seven experiments carried on in four localities—Flat Island, Nubble Point, Cape Starichkof, and Nikishka Bay. Four species of salmon were tagged, approximately 41 per cent of the total number being reds, 44 per cent pinks, 12 per cent chums, and 3 per cent cohos. Some of the tagging was done during the early part of the season and some later, when the run was at its maximum. Preliminary reports of recaptures showed that the pinks and chums were taken almost exclusively in the lower inlet from Kachemak Bay to Port Dick, while the reds were taken in all parts of Cook Inlet where commercial fishing was permitted and also at Montague Island, Port Etches, and Valdez Arm in Prince William Sound, and in Uganik Bay on Kodiak Island.

The Prince William Sound tagging operations were conducted in nine experiments at five different localities during the early part, the height, and the latter part of the season. Of the number of fish tagged, approximately 97 per cent were pinks and the remainder were largely chums.

Complete returns on recaptures have not been received, but a separate report on the work will be published.

SALMON LIFE-HISTORY STUDIES

Scientific investigations in connection with the life-history studies of Pacific salmons were continued under the direction of Dr. Willis H. Rich, who spent several weeks in the Karluk district during the early part of the season, going thence to Prince William Sound, and the southeast Alaska district. The scope of the work for 1929 was extended to include the beginning of a detailed study of the red salmon runs of Copper River and of the pink salmon of southeast Alaska, the latter particularly to test the parent stream theory with respect to this species. The investigation concerning the pink salmon was carried on by Dr. Frederick A. Davidson, associate aquatic biologist, formerly head of the zoology department of Beloit College. Assistants of Doctor Rich in the study of the red salmon runs were Seton H. Thompson in the Prince William Sound and Cook Inlet areas, Merrill W. Brown at Karluk, and Harlan B. Holmes at Chignik. Alan C. Taft was engaged at Stanford University, Calif. in examination of scales and statistics of red salmon of Bristol Bay.

Extensive collections of scales of red salmon were made in various districts and a considerable number of pink salmon fry were collected in southeast Alaska for scientific study. Approximately 50,000 young red salmon were marked at Karluk and a somewhat larger number at Chignik. Reports of the investigations will be published in separate documents.

OBSERVATIONS ON THE ESCAPEMENT OF SALMON

During the period of the salmon runs escapement conditions are noted, and at the close of the season careful surveys of the spawning grounds are made by bureau employees in all districts. If signs of depletion are evident in any locality, or if it appears that less than the required 50 per cent of the run has escaped for seeding the beds, regulatory measures are revised accordingly in order that the yield of the fisheries may be maintained at a maximum level.

Southeast Alaska.—Although the run of pink salmon, the mainstay of the industry in southeast Alaska, was considerably smaller than in the preceding year, it was vastly greater than the run in 1927, with which it may more properly be compared, as that was the beginning of the life cycle of the pinks which returned from the ocean this year. The marked improvement in certain districts fully justifies the conservation policy of the bureau, and it is the consensus of opinion that but for the timely action in rigorously curtailing commercial operations in 1927 the production for 1929 would have been no greater than it was then.

On the west coast of Prince of Wales Island there was a good escapement in Klawak and Nutkwa Inlets, as well as to the south of the latter, but in the north part of the district many streams were not well seeded. On the east shore of the island from Cape Chacon to Luck Point the run was decidedly poor, and various spawning streams in this area were not fully seeded. Such large streams as Karta River, Thorne River, Mineral Lake Creek, Kegan Cove, and a few others had comparatively good escapements of pink salmon, though very much smaller than in 1928. It is possible that a considerable part of the run destined for the east shore of Prince of Wales Island was driven eastward by the prevailing westerly and southwesterly winds, as there was an unusually heavy run on the west shore of Gravina Island.

The extreme southeastern portion of the district, including Duke Island, Kanagunut and Sitklan Islands, the Cape Fox shore, Revillagigedo Channel and its tributaries, and the eastern end of Nichols Passage, had much smaller runs of all species of salmon in 1929 than in 1928, especially during the active fishing season. After the close of commercial operations, however, excellent escapements of pink salmon were noted in Boca de Quadra, Very Inlet, and at other points in the southern part of the area, and while some of the streams were not adequately seeded, there were many others which had a large escapement and these were well distributed. Behm Canal streams were in general very well seeded.

Examination along the western shore of Cleveland Peninsula and through Ernest Sound after the close of commercial fishing showed a generally small escapement. On the western shore of the peninsula there are but few salmon streams, and these are of little importance; but in the area north and east of Lemesurier Point and along the southern shore of Etolin Island a number of streams have excellent spawning grounds insufficiently seeded for years. In the Wrangell district the escapement in most of the streams was equal to or better than that of 1928, although in a few places it was smaller.

Through the Icy Strait region and vicinity the run of pink salmon was fair, the run of reds showed a substantial increase over the preceding year, while chums and cohos were below normal. The Yakutat district had a satisfactory run and escapement of reds and pinks and a fair escapement of kings, but the run of cohos was poor, making it necessary to close certain areas to commercial fishing 10 days earlier than originally specified in the regulations, which materially assisted the escapement.

In general, the run of pink salmon in southeastern Alaska was fair but irregular, and the escapement into the streams was irregular—some streams being heavily seeded, while others in the immediate vicinity had far less than an adequate number of spawning fish. The run of red salmon was much larger than in the preceding year, while the runs of cohos and chums were below normal.

Prince William Sound and Copper River region.—The salmon runs in this district were generally good, all species except cohos showing increases over the preceding year. The escapement of pinks along the west shore of Prince William Sound was somewhat larger than in 1928, while on the east shore it was smaller, although an increase in the number of chums largely made up for the shortage. Montague Island streams were well supplied with spawning salmon. In the Resurrection Bay area the run was about 15 per cent less than in the previous year, but as the fish began to appear at the head of the bay somewhat earlier than usual and about a week before the fishing season opened and as unfavorable weather prevented operations during part of the season, a fair escapement was assured. At Eyak Lake, also, the run was estimated to be about 15 per cent below that of last year. Spawning salmon in the Copper River were more abundant in 1929 than in the preceding year, which was considered the best since 1924. Good runs entered Bering River from June 14 to 22 and from June 30 to July 4, and with the exception of comparatively small numbers caught for local use all escaped to the spawning grounds.

Cook Inlet.—While there were small numbers earlier in all parts of the district, the main run of red salmon struck at Salamato Beach on July 17 and continued for 5 days—48 hours of which was in the weekly closed period, permitting a satisfactory escapement into Kenai and Kasilof Rivers. Later, an investigation of the spawning grounds tributary to Tustemena Lake at the head of Kasilof River showed that all streams had been bountifully seeded. The spawning beds at the head of Bishop Creek and Swansons Creek were also visited and were reported to be well seeded. Streams tributary to Kachemak Bay, Seldovia Bay, and other lower Cook Inlet areas showed an average escapement of pinks.

Kodiak-Afognak district.—Throughout the district the run of red salmon was very light, but the escapement was much greater than the catch. The run of cohos was small during the fishing season, although later a larger run than usual was noted, most of which entered the streams. There was a heavy run of chum salmon and a good catch, and examination of streams at the close of the season showed an unusually large escapement. The run of pink salmon was large in Alitak Bay and on the south shore of Kodiak Island, fair along the north shore and Shelikof Strait, and rather light on the mainland shore. Although catches of this species were large, the escapement generally was satisfactory. King salmon appeared in about the usual numbers.

Alaska Peninsula.—The runs of red salmon, both local and migratory, in the Alaska Peninsula region were very irregular—in some instances good, but generally poor. The escapement of the local runs was satisfactory in most places, inasmuch as the fishermen devoted attention to the catch of chums and pinks rather than the intermittent runs of reds, but it is noted that certain areas which had poor escapements in 1928, namely Middle Lagoon in Morzhovoi Bay, Thin Point Lagoon, and Wosnesenski Creek, likewise had poor escapements this year. The Port Moller region again had a good run and escapement of red salmon. The number of chum salmon was average and pinks were above normal for any off year. Although fishing was heavy, an adequate spawning reserve entered the streams. The run of cohos was probably the lightest in many years.

Bristol Bay Area.—A heavy early run of red salmon in Bristol Bay gave promise of an unusually good season, which, however, was not fulfilled by later developments. While the run as a whole was considerably smaller than in 1928, it compared favorably with the average for recent years and exceeded that of 1924, from which it was chiefly derived, the normal life cycle of the Bristol Bay salmon being five years. The greatest gain was made in the Nushagak and Egegik districts, with the Kvichak and Naknek districts about on a par with the previous cycle. The number of salmon ascending the Ugashik River has been falling off for several years and showed a further decline in 1929. While the escapement in general throughout the Bristol Bay area was fair in comparison with the run, it was not nearly sufficient for adequate seeding of the extensive spawning grounds.

As in preceding years, Agent Dennis Winn made an examination of the Iliamna-Lake Clark region, where conditions seemed to be much the same as those observed in 1924. A report of his observations is printed elsewhere in this document.

HATCHERIES

EXTENT OF OPERATIONS

Salmon propagation in Alaska was carried on at two Government-owned hatcheries (at Afognak and McDonald Lake) and at one privately owned hatchery—that of the Northwestern Fisheries Co. at Hugh Smith Lake.

Operations of Federal and private hatcheries in Alaska in 1929

Location of hatchery	Red or sockeye salmon		
	Eggs taken in 1928	Salmon liberated in 1928–29	Eggs taken in 1929
Afognak	20,442,925	18,700,000	[1] 22,000,120
McDonald Lake	24,036,000	20,440,000	[2] 16,095,000
Hugh Smith Lake (Quadra)	20,310,000	19,340,000	11,760,000
Total	64,788,925	58,480,000	49,855,120

[1] Shipped 4,553,200 eyed red-salmon eggs to Seattle in October.
[2] Also 150,000 steelhead-trout eggs and 2,650,000 pink-salmon eggs were collected. Of the latter 1,021,000 eyed eggs were shipped to Seattle in October for delivery to the State hatchery at Auburn, Wash.

AFOGNAK

The Federal salmon hatchery at Afognak produced and liberated in Litnik Lake and its tributaries 18,700,000 red-salmon fingerlings No. 1 from the 20,442,925 eggs collected in 1928, the loss on the take being 8.5 per cent.

The collection of red-salmon eggs began on August 5, 1929, and ended on September 24, with a total take of 22,000,120. Of these, 4,553,200 eyed eggs were shipped to Seattle in October for distribution.

Persistent effort has been directed toward the extermination of Dolly Varden trout in Litnik Lake for the past several years and as a result the number of these predatory enemies of the salmon now in evidence is negligible.

M'DONALD LAKE

At the Federal salmon hatchery on McDonald Lake 18,000,000 red-salmon fingerlings Nos. 1 and 2 were released in May and June and 2,440,000 fingerlings No. 2 in July from the 24,036,000 eggs taken in 1928. In addition, a shipment of 2,493,000 eyed eggs had been made to Seattle in October, 1928, making the net loss on the total take 4.6 per cent.

There were 16,095,000 red-salmon eggs collected at this station from September 3 to October 4, 1929, and 2,650,000 pink-salmon eggs from August 27 to September 17. A shipment of 1,021,000 eyed pink-salmon eggs was forwarded to Seattle in October to be delivered to the State hatchery at Auburn, Wash. Also there were 150,000 steelhead-trout eggs collected in the spring of 1929, from which 82,000 fingerlings No. 2 were produced and released in Lake McDonald in August.

HUGH SMITH LAKE (QUADRA)

The Northwestern Fisheries Co. liberated 19,340,000 red-salmon fry from its hatchery near Boca de Quadra in 1929, hatched from 20,310,000 eggs taken in 1928, a loss of 4.8 per cent. Egg collecting in 1929 began on August 12 and ended on November 15, the total take being 11,760,000 red-salmon eggs. This was considerably less than the number usually collected and was due to heavy rains during that period which caused the lake and river to rise to flood proportions and prevented securing sufficient ripe fish for a large egg take.

HATCHERY REBATES

The owners of private salmon hatcheries in Alaska who are also packers of canned salmon receive a rebate on license fees and taxes of every nature on their catch and pack of salmon at the rate of 40 cents per 1,000 king or red salmon fry liberated by them in Alaskan waters. In the fiscal year ending June 30, 1929, only one such private salmon hatchery was operated—that of the Northwestern Fisheries Co. at Hugh Smith Lake—and the rebate due on the 19,340,000 red-salmon fry liberated there during the year amounted to $7,736.

GENERAL STATISTICS OF THE FISHERIES

The total number of persons engaged in the fisheries of Alaska in 1929 was 29,283, or 1,803 less than in 1928. Fishery products were valued at $50,795,819—a decrease of $3,749,769, or about 7 per cent, from the preceding year. Of the total amount, 83.7 per cent represented the value of salmon products; 8.7 per cent, halibut; 5.5 per cent, herring; and 2.1 per cent, the value of all other fishery products.

Summary of persons engaged and products of the Alaska fisheries in 1929

Items	Southeast Alaska		Central Alaska		Western Alaska		Total	
	Number	Value	Number	Value	Number	Value	Number	Value
PERSONS ENGAGED								
Whites	7, 190		4, 564		4, 318		16, 072	
Natives	3, 200		1, 093		1, 072		5, 365	
Chinese	325		245		389		959	
Japanese	605		479		293		1, 377	
Filipinos	1, 842		1, 221		980		4, 043	
Mexicans	22		127		1, 040		1, 189	
Kanakas	27		12		12		51	
Porto Ricans			3		37		40	
Negroes	1		30		114		145	
Miscellaneous	4		2		36		42	
Total	13, 216		7, 776		8, 291		29, 283	
PRODUCTS								
Salmon:								
Canned ... cases	2, 101, 211	$13, 660, 521	2, 084, 503	$14, 837, 985	1, 184, 445	$11, 970, 879	5, 370, 159	$40, 469, 385
Mild cured ... pounds	4, 318, 400	1, 200, 147	228, 800	41, 576			4, 547, 200	1, 241, 723
Pickled ... do	77, 800	8, 040	272, 300	35, 963	331, 300	29, 017	681, 400	73, 020
Fresh ... do	1, 195, 012	108, 373	17, 000	2, 300			1, 212, 012	110, 673
Frozen ... do	4. 390, 289	428, 348	4, 880	270			4, 395, 169	428, 618
Dry-salted, dried, and smoked ... do	3, 123	165	2, 300	345	1, 433, 616	129, 610	1, 439, 039	130, 120
Fertilizer ... do	1, 245, 200	31, 364	401, 970	10, 049			1, 647, 170	41, 413
Oil ... gallons	55, 260	20, 535	18, 715	9, 358			73, 975	29, 893
Halibut:								
Fresh ... pounds	27, 683, 371	3, 359, 217	3, 000	450			27, 686, 371	3, 359, 667
Frozen ... do	7, 988, 602	879, 655	1, 782, 025	183, 283			9, 770, 627	1, 062, 938
Herring:								
Fresh, for bait ... do	4, 043, 990	51, 553	457, 800	6, 863			4, 501, 790	58, 416
Frozen, for bait ... do	4, 352, 495	34, 729	23, 600	590	43, 000	1, 075	4, 419, 095	36, 394
Frozen, for food ... do	47, 200	1, 416			69, 477	3, 474	116, 677	4, 890
Pickled, for food—								
Scotch cure ... do	1, 244, 250	88, 609	200, 250	13, 660	5, 100, 625	425, 115	6, 545, 125	527, 384
Norwegian cure ... do	91, 165	5, 703			37, 400	3, 500	128, 565	9, 203
Roused, for food (bloater stock) ... do					149, 200	7, 500	149, 200	7, 500
Spiced ... do	9, 200	1, 010					9, 200	1, 010
Dry-salted ... do					150, 000	8, 000	150, 000	8, 000
Meal ... do	23, 872, 093	691, 484	1, 627, 161	42, 762			25, 499, 254	734, 246
Oil ... gallons	3, 120, 307	1, 316, 754	220, 872	90, 287			3, 341, 179	1, 407, 041

Summary of persons engaged and products of the Alaska fisheries in 1929—Continued

Items	Southeast Alaska		Central Alaska		Western Alaska		Total	
	Number	Value	Number	Value	Number	Value	Number	Value
PRODUCTS—continued								
Cod:								
Dry-salted ... pounds			704,538	$38,306			704,538	$38,306
Stockfish ... do			8,700	1,370			8,700	1,370
Tongues ... do			600	80			600	80
Whale:								
Oil ... gallons			426,700	226,706	359,000	$186,685	785,700	413,391
Sperm oil ... do			12,250	4,500	35,500	13,300	47,750	17,800
Fertilizer ... pounds			1,352,000	35,015	1,270,000	33,575	2,622,000	68,590
Pickled meat ... do					36,314	1,500	36,314	1,500
Whalebone ... do					16,000	800	16,000	800
Clams ... cases			28,001	203,656			28,001	203,656
Crabs:								
Meat ... pounds	70,979	$26,870	117,140	44,513			188,119	71,383
Whole in shell ... dozen	377	754	485	728			862	1,482
Shrimp ... pounds	497,750	200,312					497,750	200,312
Trout:								
Canned ... cases			4	20			4	20
Fresh ... pounds	42,540	6,203	6,200	1,000			48,740	7,203
Frozen ... do	26,116	2,078	22,077	1,958			48,193	4,036
Sablefish:								
Fresh ... do	4,321	157					4,321	157
Frozen ... do	462,174	22,129					462,174	22,129
Pickled ... do	5,600	420					5,600	420
Smelt:								
Fresh ... do	3,880	392					3,880	392
Frozen ... do	1,286	141					1,286	141
Rockfishes, fresh ... do	460	9					460	9
"Lingcod":								
Fresh ... do	13,400	316					13,400	316
Frozen ... do	26,398	792					26,398	792
Total		22,148,196		15,833,593		12,814,030		[1] 50,795,819

[1] These figures represent the value of the manufactured product. It is estimated that the value of the catch, exclusive of whales, to the fishermen was approximately $16,582,000. The round weight of the salmon catch landed by the fishermen was approximately 442,601,784 pounds, and the corresponding figures for herring were approximately 153,105,752 pounds. The cod figures given above do not include the offshore catch from waters adjacent to Alaska, which amounted to 6,087,551 pounds of dry-salted cod and 13,200 pounds of tongues, having a total value of $352,501, landed at ports of the Pacific Coast States.

SALMON

Although the production of salmon in Alaska in 1929 was somewhat less than that for 1928, when the output ranked third in the history of the industry, it was on the whole very satisfactory, the total value of the products being $42,524,845, as against an average of $36,494,125 for the previous decade. Of the five species of salmon, there was but one—the king salmon—that showed an increase in catch over the preceding year, and each of the three main districts of Alaska shared in this gain. In the catch of other species, however, the decrease was not distributed among all districts.

The total catch of salmon decreased approximately 20 per cent from that for 1928. In southeast Alaska the catch of pinks, cohos, and chums decreased, while kings and reds increased. It should be noted, however, that the run of pink salmon, which is the most important species in this district, showed a marked improvement as compared with the run at the beginning of the cycle (1927) and the catch in 1929 was more than twice what it was then. In central Alaska the catch of cohos was less than one-half that of the preceding year, while reds showed a comparatively small decrease, the scarcity of this species in the Kodiak area being largely offset by increases in the Chignik and Copper River regions. The catch of chums in central Alaska greatly exceeded that of any previous year, while the number of pink salmon was the third largest ever taken in that district. In western Alaska, where red salmon make up the bulk of the catch, there was a considerable decrease of that species only, but its effect was somewhat reduced by the unusually large size of the fish. By districts, the decrease in catch from the previous year was approximately 37 per cent in both southeastern and western Alaska, while in central Alaska the catch increased 32 per cent.

There was an increase of 8 per cent for the whole of Alaska in the number of fathoms of seines used, while the number of fathoms of gill nets decreased about 4 per cent and the number of traps about 2 per cent from those in operation in 1928.

CATCH AND APPARATUS

The total number of seines used in the salmon industry in 1929 was 795, of which 172 were beach seines and 623 purse seines. The beach seines aggregated 19,679 fathoms of webbing and the purse seines 98,308 fathoms. The number of gill nets used was 4,121, having a total length of 288,590 fathoms. There were 292 driven traps and 422 floating traps—a total of 714.

Southeastern Alaska was accredited with 469 seines, or a total of 81,393 fathoms of webbing, a decrease of 4 seines but an increase of 834 fathoms of webbing over the number in 1928; also with 321 gill nets, aggregating 25,480 fathoms, a decrease of 30 nets but an increase of 2,813 fathoms; and with 66 driven and 378 floating traps, a decrease of 5 driven and 4 floating traps from the number operated in 1928.

Corresponding figures for central Alaska show 313 seines, or 33,779 fathoms, as compared with 230 seines or 25,923 fathoms in 1928; 1,808 gill nets, or 98,030 fathoms, as compared with 1,290 gill nets or 77,065 fathoms in 1928; and 224 driven and 44 floating traps, as compared with 232 and 43, respectively, in 1928.

In western Alaska 13 seines, or 2,815 fathoms of webbing, were used, a decrease from 1928 of 2 seines but an increase in webbing of 15 fathoms. There were 1,992 gill nets used, or an aggregate length of 165,080 fathoms, an increase of 2 nets but a decrease of 37,206 fathoms of webbing. Two driven traps—the same number as in the previous year—were operated.

Seines caught 26 per cent of the salmon taken in 1929, gill nets 21 per cent, and traps 51 per cent, while lines and wheels took the remaining 2 per cent.

Percentage of salmon caught in each Alaska district, by principal forms of apparatus

Apparatus	Southeast Alaska		Central Alaska		Western Alaska	
	1928	1929	1928	1929	1928	1929
Seines	25	23	29	38	4	7
Gill nets	1	2	7	7	93	89
Traps	71	72	64	55	1	1
Lines	3	3				
Wheels					2	3

The total catch of salmon in 1929 was 71,939,618, a decrease of 17,645,067, or 19.7 per cent, from the number taken in 1928. In southeastern Alaska and western Alaska the decrease was 16,616,610 and 8,260,744, respectively, while central Alaska showed a gain of 7,232,287. The catch by species shows that cohos decreased 1,571,-758, chums 738,534, pinks 7,086,726, and reds 8,359,615, while kings increased 111,566.

Salmon taken in 1929, by apparatus and species, in each geographic section of Alaska

Apparatus and species	Southeast Alaska	Central Alaska	Western Alaska	Total
Seines:				
Coho, or silver	129, 329	56, 019		185, 348
Chum, or keta	1, 034, 800	2, 408, 471	150, 231	3, 593, 502
Pink, or humpback	4, 925, 839	8, 624, 102	89, 169	13, 639, 110
King, or spring	625	491	5, 503	6, 619
Red, or sockeye	309, 864	293, 454	685, 777	1, 289, 095
Total	6, 400, 457	11, 382, 537	930, 680	18, 713, 674
Gill nets:				
Coho, or silver	118, 594	297, 796	30, 513	446, 903
Chum, or keta	56, 031	94, 080	1, 108, 860	1, 258, 971
Pink, or humpback	207, 887	216, 800	3	424, 690
King, or spring	24, 082	81, 569	136, 275	241, 926
Red, or sockeye	293, 865	1, 422, 822	11, 272, 140	12, 988, 827
Total	700, 459	2, 113, 067	12, 547, 791	15, 361, 317
Traps:				
Coho, or silver	624, 287	403, 289		1, 027, 576
Chum, or keta	1, 527, 694	2, 602, 409	14, 687	4, 144, 790
Pink, or humpback	16, 707, 608	9, 653, 564		26, 361, 172
King, or spring	6, 138	60, 206	1, 566	67, 910
Red, or sockeye	1, 297, 633	3, 449, 077	160, 280	4, 906, 990
Total	20, 163, 360	16, 168, 545	176, 533	36, 508, 438

Salmon taken in 1929, by apparatus and species, in each geographic section of Alaska—Continued

Apparatus and species	Southeast Alaska	Central Alaska	Western Alaska	Total
Lines:				
Coho, or silver	496, 232	3, 640		499, 872
Chum, or keta	8, 380			8, 380
Pink, or humpback	7, 160			7, 160
King, or spring	424, 646	40		424, 686
Red, or sockeye	99			99
Total	936, 517	3, 680		940, 197
Wheels:				
Chum, or keta			389, 000	389, 000
King, or spring			26, 992	26, 992
Total			415, 992	415, 992
Total:				
Coho, or silver	1, 368, 442	760, 744	30, 513	2, 159, 699
Chum, or keta	2, 626, 905	5, 104, 960	1, 662, 778	9, 394, 643
Pink, or humpback	21, 848, 494	18, 494, 466	89, 172	40, 432, 132
King, or spring	455, 491	142, 306	170, 336	768, 133
Red, or sockeye	1, 901, 461	5, 165, 353	12, 118, 197	19, 185, 011
Grand total	28, 200, 793	29, 667, 829	14, 070, 996	71, 939, 618

CANNING

CHANGES IN CANNERIES

The six plants of the Alaska Consolidated Canneries were sold at the beginning of the year to the owners of the Sunny Point Packing Co., who then reorganized the company under the name of the Alaska Pacific Salmon Corporation. Soon afterwards the Port Althorp plant of the Deep Sea Salmon Co. was acquired by this organization, giving it 10 plants in southeastern Alaska, 4 of which were closed for the season. The cannery of the Petersburg Packing Co. at Petersburg was sold to the Pacific American Fisheries, although operations were continued under the former name. Libby, McNeill & Libby bought the Karheen Packing Co.'s cannery at Karheen and the Klawak cannery of the North Pacific Trading & Packing Co. and operated the plants in 1929. Their interests in this district were further expanded by the purchase of the Sea-Coast Packing Co.'s plant at Craig at the close of the season. The New England Fish Co. acquired the cannery of Geo. T. Myers & Co. at Chatham. The sale of the Klawak plant by the North Pacific Trading & Packing Co. and the Chatham plant by Geo. T. Myers & Co. marks the retirement of pioneers in the salmon-canning industry, the former company having established the first plant in Alaska at Klawak in 1878 and the latter having operated the Chatham cannery since 1904, while its operations on Columbia River and Puget Sound began in the seventies.

The Columbia River Packers Association purchased the F. C. Barnes Co.'s plant at Lake Bay, which had been operated under lease in 1928 by the Lake Bay Packing Co. The plant of the Mountain Point Packing Co. on Wrangell Narrows, which was idle in 1928, was taken over and operated during the season by the Wrangell Narrows Packing Co. The Alaska Pacific Fisheries acquired properties of the Alaska Sanitary Packing Co., including traps, floating equipment, and the cannery site at Wrangell, and joint operations of these properties with those of the Whitworth Fisheries (Inc.) were carried on by a new organization, the Alaska Associated Canneries, the pack being prepared at the Whitworth cannery at Point Warde. The Nakat Packing Corporation purchased the cannery at Heceta Island which it had operated under lease from the Swift-Arthur-Crosby Co. since 1922, but the fish were packed at its Waterfall cannery for the season.

The Alaska Pacific Salmon Corporation acquired and operated the Gorman Packing Corporation's plant at Drier Bay and operated under lease the plant of the Franklin Packing Co. at Port Ashton. The Pacific American Fisheries took over the cannery of the Alitak Packing Co. at Alitak and the cannery of the Robinson Packing Corporation at Zachar Bay, operating both plants under the name of the Alitak Fish Co. A new organization, the Alaska Fishermen's Cooperative Packing Co., purchased the floating plant *Santa Flavia*, which had been operated formerly by the International Packing Co. on Ugashik River and Makushin Bay in western Alaska, and packed salmon at Fox Bay on the south side of the Alaska Peninsula. In that locality, also, as well as in Herendeen Bay for a part of the season, the Everett Packing Co. operated its floating plant *Mazama*, which had been used in southeastern Alaska the previous year. The Seashore Packing Co. again leased the salmon and clam cannery of the Hemrich Packing Co. at Kukak Bay which it had operated for the 3-year period from 1925 to 1927, inclusive.

Other changes of ownership of canneries in the central district were as follows: The cannery of Edward Gustan at Point Possession was operated by the partnership Gustan & Hartley; George Valaer's cannery on Nikishka Bay was taken over by a new firm, the Spur Fish Corporation; the Anderson Mercantile Co. succeeded W. A. Keller in operation of the plant at Deep Creek; E. Sandvik carried on operations at the Swansons Creek plant started the previous season by Nordin and Sandvik; Chas. W. Pajoman continued operation of the plant at Iron Creek formerly owned by Pajoman & Trout; and the Glacier Packing Co. took over the floating plant of the Orca Packing Co. at Cordova.

The Alaska-Portland Packers Association carried on operations during the season as a unit of the Pacific American Fisheries organization, its plants on the Naknek River and Nushagak Bay having been purchased by the latter company. The Herendeen Bay Consolidated Canneries operated the plant formerly known as that of the Everett Packing Co. at Herendeen Bay.

NEW CANNERIES

Three new canneries were operated in southeast Alaska. These include a new plant erected by the Independent Salmon Canneries at Ketchikan, its former location at that place being taken over and operated by the Iwersen Packing Co., a new firm in the salmon-canning business. The Wrangell Packing Corporation operated a 1-line plant at Wrangell, and the Mitkof Packing Co. put up a small pack of halves aboard the floating plant *Resolute*, which was used also in mild-curing operations.

Nine canneries were operated for the first time in central Alaska. Five of these were on Cook Inlet and include four hand canneries operated, respectively, by the Ninilchik Packing Co. at Ninilchik, Point

Possession Fish Co. at Point Possession, Harvey Smith at West Foreland, and West Coast Canning Co. on Tuxedna Bay. The Kustatan Packing Co. established and operated a new cannery at Kustatan. The Blue Island Packing Co. installed the necessary machinery and operated a 1-line cannery in its herring saltery building at Blue Fox Bay on Afognak Island. The Shelikof Packing Co., a new firm organized by Roy Trout (formerly of the partnership Pajoman & Trout) and his associates, operated a 1-line plant at Zachar Bay. The Union Fish Co. prepared a pack of salmon near Pirate Cove aboard the *Costa Rica*, which had formerly been used as a transporter by the Alaska Salmon Co. and was equipped as a floating cannery

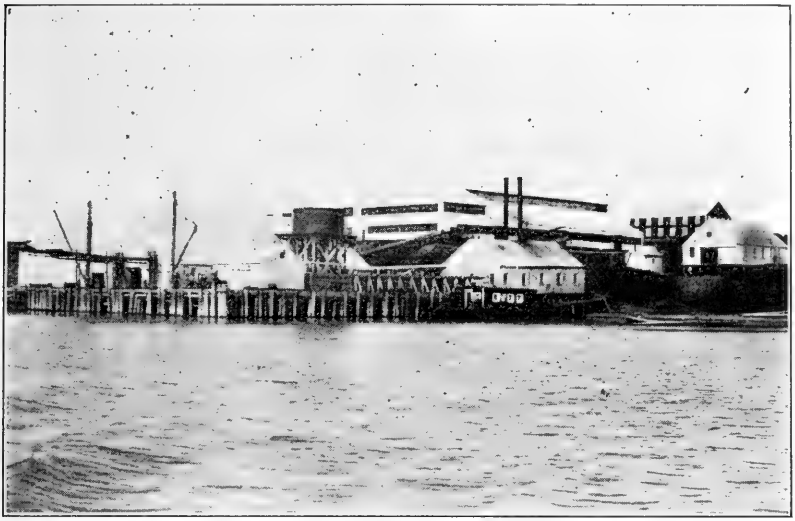

FIGURE 5.—Modern salmon cannery, western Alaska

before the beginning of the 1929 season. Seward Fisheries (Inc.) put up a pack of canned salmon at Seward.

Small packs were prepared by A. N. Nilson at Portlock, Wik & Berg at Redoubt Bay, and Albert and John Sandvik at Uganik Bay, but these have not been included in the list of canneries.

CANNERIES NOT OPERATED

The Alaska Pacific Salmon Corporation did not operate its plants at Boca de Quadra, Pybus Bay, Tenakee, and Yes Bay, nor did the Nakat Packing Corporation prepare a salmon pack at its Heceta Island cannery in 1929. Of the plants in central Alaska which had been operated in the preceding season, those of the Pacific American Fisheries at Bering River and Unakwik Inlet, Gorman & Co. at Anchorage, W. G. Culver at Point McManus, and the Kenai River Packing Co. at Kenai were closed this year.

The cannery of the Tongass Packing Co. at Nakat Inlet and that of the Northwestern Fisheries Co. at Roe Point have been dropped from the list of idle plants because of the improbability of their being reopened, the former having been dismantled and the latter having been almost completely destroyed by fire.

The following canneries were closed during the year but may be reopened:

Southeastern Alaska:	
Alaska Pacific Salmon Corporation	Boca de Quadra. Pybus Bay. Tenakee. Yes Bay.
Alaska Packers Association	Wrangell.
Alaska Sanitary Packing Co	Cape Fanshaw.
Hoonah Packing Co	Hoonah. Gambier Bay.
The Nakat Packing Corporation	Heceta Island.
Northwestern Fisheries Co	Santa Ana.
Pacific American Fisheries	Port Walter.
Central Alaska:	
Alaska Packers Association	Kasilof.
W. G. Culver	Point McManus.
Gorman & Co	Anchorage.
Kenai River Packing Co	Kenai.
Kodiak Island Fishing & Packing Co	Seward.
Northwestern Fisheries Co	Seldovia.
Pacific American Fisheries	Bering River. Unakwik Inlet.
Western Alaska: Alaska Salmon Co	Kvichak Bay.

TOTAL CANNERIES OPERATED

There were 156 canneries operated in Alaska in 1929—59 in southeastern, 68 in central, and 29 in western, which is 2 less in south-

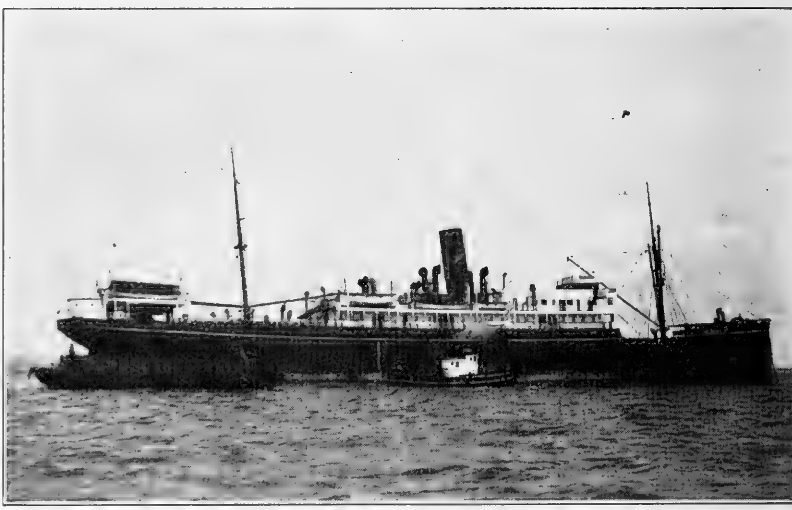

FIGURE 6.—Salmon cannery steamer in western Alaska

eastern, 6 more in central, and 1 less in the western district than in 1928, a net gain of 3 plants. The International Packing Co. operated its floating cannery *International* in both the central and western districts, and the Everett Packing Co.'s floating plant *Mazama* was likewise operated in those two districts, but each is included but once in the total, the former being credited to western and the latter to central Alaska.

Companies that canned salmon in Alaska, number and location of canneries operated, and number of traps owned by each, 1929

[New canneries indicated by (*)]

Company	Canneries		Traps		
	Number	Location	Driven	Floating	Total
Southeast Alaska:					
Alaska Associated Canneries	1	Point Warde		6	6
Alaska Pacific Salmon Corporation	6	Chomly	2	2	4
		Funter Bay	1	20	21
		Kake	1	14	15
		Ketchikan	3	11	14
		Port Althorp		14	14
		Rose Inlet		5	5
Alaska Packers Association	1	Loring	3	4	7
Annette Island Packing Co	1	Metlakatla	5	2	7
Astoria & Puget Sound Canning Co	1	Excursion Inlet	1	7	8
Bayview Packing Co	1	Klawak			
Beegle Packing Co	1	Ketchikan	1	2	3
Burnett Inlet Packing Co	1	Burnett Inlet		3	3
Columbia River Packers Association	1	Lake Bay		7	7
Demmert Packing Co	1	Klawak		5	5
Diamond K Packing Co	1	Wrangell (floating)		7	7
Douglas Island Packing Co	1	Douglas			
Far North Fisheries, Inc	1	Hydaburg		1	1
Fidalgo Island Packing Co	2	Bay of Pillars	7		7
		Ketchikan	4	3	7
Haines Packing Co	1	Letnikof Cove			
P. E. Harris & Co	1	Hawk Inlet		7	7
Hetta Packing Co	1	Coppermount			
Hood Bay Canning Co	1	Hood Bay		7	7
Independent Salmon Canneries	1	Ketchikan			
Iwerson Packing Co	1	Ketchikan*			
Libby, McNeill & Libby	5	George Inlet		6	6
		Karheen	1	4	5
		Klawak		6	6
		Taku Harbor	9	6	15
		Yakutat			
Mitkof Packing Co	1	Tee Harbor (floating) *			
Nakat Packing Corporation, The	4	Hidden Inlet		6	6
		Ketchikan		6	6
		Union Bay		9	9
		Waterfall		16	16
New England Fish Co	3	Chatham	2	9	11
		Ketchikan		7	7
		Noyes Island		7	7
Northwestern Fisheries Co	5	Boca de Quadra	5	3	8
		Dundas Bay		4	4
		Hunter Bay		5	5
		Kasaan	2	10	12
		Shakan		7	7
Pacific American Fisheries	2	Excursion Inlet	5	5	10
		Ketchikan	2	4	6
Peril Straits Packing Co	1	Todd		5	5
Petersburg Packing Co	1	Petersburg	3	8	11
Pyramid Packing Co	1	Sitka		5	5
Red Salmon Packers Association	1	Dry Bay and Yakutat (floating).			
Sea-Coast Packing Co	1	Craig		8	8
Sebastian-Stuart Fish Co	1	Tyee		7	7
Starr-Collinson Packing Co	1	Moira Sound		3	3
Straits Packing Co	1	Skowl Arm		1	1
Stuart Corporation, The	1	Ketchikan		5	5
Superior Packing Co	1	Tenakee		5	5
Ward's Cove Packing Co	1	Ward Cove		3	3
Wrangell Narrows Packing Co	1	Mountain Point			
Wrangell Packing Corporation	1	Wrangell*	1	1	2
Central Alaska:					
Alaska Fishermen's Cooperative Packing Co.	1	Fox Bay (floating)			
Alaska General Fisheries	1	Anchorage	9		9
Alaska Pacific Salmon Corporation	2	Drier Bay		4	4
		Port Ashton		8	8
Alaska Packers Association	3	Alitak	4		4
		Chignik	4		4
		Karluk	4		4
Alaska Year Round Canneries Co	1	Seldovia	7		7
Alitak Fish Co	2	Alitak	4		4
		Zachar Bay	3		3
Anderson Mercantile Co. (Inc.)	1	Deep Creek	2		2
Arctic Packing Co	1	Port Graham	1		1

Companies that canned salmon in Alaska, number and location of canneries operated, and number of traps owned by each, 1929—Continued

[New canneries indicated by (*)]

Company	Canneries		Traps		
	Number	Location	Driven	Floating	Total
Central Alaska—Continued.					
Blue Island Packing Co	1	Blue Fox Bay*			
Columbia River Packers Association	1	Chignik	4		4
Cook Inlet Packing Co	1	Seldovia	9		9
Copper River Packing Co	1	McClure Bay		9	9
Cordova Packing Co	1	Cordova	1		1
Crosby Fisheries (Inc.)	1	Zachar Bay and Cordova (floating).	5		5
H. J. Emard	1	Anchorage	4		4
Emel Packing Co	1	Valdez	4		4
Everett Packing Co	1	Fox Bay (floating)			
Fidalgo Island Packing Co	1	Port Graham	10		10
Glacier Packing Co	1	Cordova (floating)	1		1
Grimes Packing Co	1	Uzinki	1		1
Gustan & Hartley	1	Point Possession	2		2
P. E. Harris & Co	1	Isanotski Strait	8		8
International Packing Co	1	Dolgoi Bay (floating)			
Kadiak Fisheries Co	2	Kodiak	7		7
		Shearwater Bay	3		3
Katmai Packing Co. (Inc.)	1	Uzinki	3		3
Kodiak Island Fishing & Packing Co	1	Uganik Bay	5		5
Kustatan Packing Co	1	Kustatan*			
Libby, McNeill & Libby	1	Kenai	20		20
New England Fish Co	2	Cordova	4	4	8
		Drier Bay			
Ninilchik Packing Co	1	Ninilchik*	1		1
North Coast Packing Co	1	do	8		8
North Pacific Fisheries (Inc.)	1	Uyak Bay (floating)			
Northern Light Packing Co	1	Mountain Slough			
Northwestern Fisheries Co	4	Chignik	2		2
		Kenai	10		10
		Orca		6	6
		Uyak			
Pacific American Fisheries	2	Ikatan	5		5
		King Cove	13		13
Charles W. Pajoman	1	Iron Creek			
Pioneer Packing Co	1	Cordova	1	3	4
Pioneer Sea Foods Co	1	do		2	2
Point Possession Fish Co	1	Point Possession*	1		1
Premier Salmon Co	1	Orca Bay	2	1	3
E. Sandvik	1	Swansons Creek			
San Juan Fishing & Packing Co	3	Evans Bay	3	2	5
		Tutka Bay	7		7
		Uganik Bay	6		6
Seashore Packing Co	1	Kukak Bay			
Seward Fisheries (Inc.)	1	Seward*			
Shelikof Packing Co	1	Zachar Bay*			
Shepard Point Packing Co	1	Shepard Point		4	4
Shumagin Packing Co	1	Squaw Harbor	3		3
Harvey Smith	1	West Foreland*			
Snug Harbor Packing Co	1	Snug Harbor	8		8
Spur Fish Corporation	1	Nikishka Bay			
Sunset Packing Co	1	Otter Creek	3		3
J. F. Toman Packing Co	1	Anchorage	1		1
Trinity Packing Co	1	Three Saints Bay			
Union Fish Co	1	Pirate Cove (floating)*			
West Coast Canning Co	1	Tuxedna Bay*			
John Wik	1	Kenai	1		1
Jake Young	1	Port Chatham			
Western Alaska:					
Alaska Packers Association	9	Egegik River			
		Kvichak Bay (2)			
		Naknek River (3)			
		Nushagak Bay (2)			
		Ugashik River			
Alaska-Portland Packers Association	2	Naknek River			
		Nushagak Bay			
Alaska Salmon Co	1	Wood River			
Bristol Bay Packing Co	1	Kvichak Bay			
Columbia River Packers Association	1	Nushagak Bay			
Everett Packing Co	1	Herendeen Bay (floating)			
Herendeen Bay Consolidated Canneries	1	Herendeen Bay			
International Packing Co	1	Ugashik River, Dutch Harbor & Makushin Bay (floating).			

Companies that canned salmon in Alaska, number and location of canneries operated, and number of traps owned by each, 1929—Continued

[New canneries indicated by (*)]

Company	Canneries		Traps		
	Number	Location	Driven	Floating	Total
Western Alaska—Continued.					
Libby, McNeill & Libby	6	Egegik River Ekuk Koggiung Libbyville Lockanok Nushagak			
Nakat Packing Corporation, The	1	Nakeen			
Northwestern Fisheries Co	2	Naknek River Nushagak			
Pacific American Fisheries	1	Port Moller	2		2
Red Salmon Canning Co	3	Naknek River (2) Ugashik River			

LOSSES AND DISASTERS

In southeastern Alaska fire destroyed the cannery of the Starr-Collinson Packing Co. at Moira Sound and that of the Wrangell Narrows Packing Co. at Mountain Point, together with supplies, and a portion of the season's pack of canned salmon at both plants, the total loss amounting to $44,409. The fires occurred on August 29 and October 24, respectively. It is expected that the plants will be rebuilt before another season. The cannery of the Northwestern Fisheries Co. at Roe Point, which had not been operated since 1920, was burned on September 17. Other property losses in southeastern Alaska to the value of $79,099 were reported, consisting of several bunk houses belonging to the Alaska Pacific Salmon Corporation at Funter Bay, which were destroyed by fire, and various small boats and fishing gear. Seven lives were lost—1 fisherman and 2 shoresmen by disease, 1 fisherman and 1 transporter by drowning, and 1 shoresman and 1 transporter by accidents.

Central Alaska operators reported losses of gear, boats, and supplies having a total value of $25,058. Twenty-one lives were lost—2 fishermen and 5 shoresmen died of disease, 5 shoresmen and 5 transporters were killed in accidents, 2 shoresmen were drowned, and 2 committed suicide.

In the western district the "Diamond P" cannery building and two warehouses of the Red Salmon Canning Co. at Naknek were destroyed by fire on April 9, with loss reported as $133,500. The work of rebuilding was begun as soon as the necessary materials could be procured from the States, and a modern building of fabricated steel construction was ready for operation by the end of June. Minor losses of small boats and gear to the value of $14,507 were reported by various companies. Twenty lives were lost—3 fishermen and 13 shoresmen died of disease, 2 shoresmen were drowned, 1 was killed accidentally, and 1 committed suicide.

In addition to the foregoing there was considerable damage to property in the Bristol Bay region by severe storms and extremely high tide on November 24, but the full extent of the losses will not be known until the plants are put in readiness for another season's operations.

STATISTICS

In 1929, 156 canneries were operated in Alaska, 3 more than in 1928. The expansion of operations was confined to the central district. Employment was given to 24,271 persons, as compared with 24,428 in 1928, a decrease of 157. White employees increased 133, natives 15, Filipinos 83, and miscellaneous 17, while Chinese decreased 117, Japanese 113, Mexicans 95, Porto Ricans 4, Kanakas 15, and negroes 61.

The total pack of canned salmon was 5,370,159 cases, valued at $40,469,385. This was a decrease of 713,744 cases, or about 12 per cent, from the pack of 1928, and a decrease in value of $4,914,500, or about 11 per cent. The output in southeastern Alaska decreased from 2,971,147 to 2,101,211 cases, or 29 per cent, and in western Alaska from 1,473,601 cases to 1,184,445, or about 20 per cent, while in central Alaska it increased from 1,639,155 to 2,084,503, or 27 per

FIGURE 7.—Canned salmon and shipping cases at Alaska cannery

cent. In Alaska as a whole the pack of cohos decreased from 298,623 cases to 171,956 cases, or 42 per cent; chums decreased from 995,785 cases to 864,512 cases, or 13 per cent; pinks from 2,787,242 cases to 2,571,657 cases, or about 8 per cent; and reds from 1,948,094 cases to 1,689,927 cases, or 13 per cent. The only increase was in the pack of kings, of which 72,107 cases were packed, as compared with 54,159 cases in 1928, an increase of 17,948 cases, or 33 per cent.

Data are included in the following tables to show comparison of the 1929 pack with the average for the five preceding years, 1924 to 1928, by cases of each species and by districts. Three species—pinks, kings, and reds—show a gain in 1929 over the 5-year average, while cohos and chums show a decline. By districts the decrease of approximately 17 per cent in southeastern Alaska was more than offset by a gain of 30 per cent in central, while the pack in western Alaska increased about 1 per cent, making a net increase for all of Alaska of 3 per cent over the 5-year average.

Persons engaged, wages paid, and operating units of Alaska salmon canning industry, 1929

Items	Southeast Alaska	Central Alaska	Western Alaska	Total
PERSONS ENGAGED				
Fishermen:				
Whites	1,095	1,634	2,057	4,786
Natives	1,668	512	143	2,323
Chinese	1		1	2
Japanese	1			1
Filipinos	2			2
Mexicans	2			2
Kanakas	3			3
Negro	1			1
Miscellaneous [1]	1			1
Total	2,774	2,146	2,201	7,121
Shoresmen:				
Whites	2,200	1,785	1,839	5,824
Natives	1,210	520	172	1,902
Chinese	317	239	388	944
Japanese	573	477	291	1,341
Filipinos	1,813	1,217	980	4,010
Mexicans	11	127	1,040	1,178
Kanakas	24	12	11	47
Porto Ricans		3	37	40
Negroes		30	114	144
Miscellaneous [1]	3	2	36	41
Total	6,151	4,412	4,908	15,471
Transporters:				
Whites	833	590	139	1,562
Natives	40	48		88
Chinese	5	6		11
Japanese	5	2		7
Filipinos	10			10
Kanaka			1	1
Total	893	646	140	1,679
Total:				
Whites	4,128	4,009	4,035	12,172
Natives	2,918	1,080	315	4,313
Chinese	323	245	389	957
Japanese	579	479	291	1,349
Filipinos	1,825	1,217	980	4,022
Mexicans	13	127	1,040	1,180
Kanakas	27	12	12	51
Porto Ricans		3	37	40
Negroes	1	30	114	145
Miscellaneous [1]	4	2	36	42
Grand total	9,818	7,204	7,249	24,271
Wages paid shoresmen	$2,402,876	$2,086,813	$1,897,582	$6,387,271
Wages paid transporters	$478,776	$346,974	$88,796	$914,546
OPERATING UNITS				
Plants:				
Shore canneries	56	62	28	146
Floating canneries—				
Power vessels	2	5	1	8
Net tonnage	335	5,169	1,700	7,204
Barges	1	1		2
Net tonnage	488	389		877
Total plants operated	59	68	29	156
Vessels:				
Power, over 5 tons	444	186	91	721
Net tonnage	9,709	10,066	30,794	50,569
Sailing		1	1	2
Net tonnage		1,590	1,965	3,555
Launches	134	217	31	382
Power dories	27	42		69
Gill-net boats	120	120	1,062	1,302
Seine skiffs	140	290	8	438
Other rowboats and skiffs	1,086	773	131	1,990
Lighters and scows	291	292	157	740
Houseboats	25	2	43	70
Pile drivers	40	45	22	107
Pile pullers	22	5	1	28
Rigging scows	34	8		42

[1] Koreans, Hawaiians, etc.

Persons engaged, wages paid, and operating units of Alaska salmon canning industry, 1929—Continued

Items	Southeast Alaska	Central Alaska	Western Alaska	Total
OPERATING UNITS—continued				
Apparatus:				
Purse seines	464	148	10	622
Fathoms	80, 893	14, 710	2, 625	98, 228
Beach seines	5	160	3	168
Fathoms	500	18, 679	190	19, 369
Gill nets	317	1, 722	[2] 1, 549	3, 588
Fathoms	25, 360	95, 195	157, 625	278, 180
Traps, driven	66	224	2	292
Traps, floating	378	44		422

[2] Includes 139 stake nets, of an average length of 25 fathoms each, used in the Bristol Bay area.

Output and value of canned salmon in Alaska in 1929 [1]

Product	Southeast Alaska		Central Alaska		Western Alaska		Total	
	Cases	Value	Cases	Value	Cases	Value	Cases	Value
Coho, or silver:								
½-pound flat	5, 216	$55, 692	2, 664	$27, 919			7, 880	$83, 611
1-pound flat	4, 488	34, 919	2, 242	15, 997			6, 730	50, 916
1-pound tall	88, 143	664, 565	66, 424	485, 214	2, 779	$20, 151	157, 346	1, 169, 930
Total	97, 847	755, 176	71, 330	529, 130	2, 779	20, 151	171, 956	1, 304, 457
Chum, or keta:								
½-pound flat	3, 965	26, 886	996	6, 975			4, 961	33, 861
1-pound tall	286, 832	1, 546, 498	496, 778	2, 638, 902	75, 941	402, 090	859, 551	4, 587, 490
Total	290, 797	1, 573, 384	497, 774	2, 645, 877	75, 941	402, 090	864, 512	4, 621, 351
Pink, or humpback:								
½-pound flat	38, 960	304, 108	5, 802	73, 162			44, 762	377, 270
1-pound flat	3, 894	27, 131	16	96			3, 910	27, 227
1-pound tall	1, 499, 761	8, 998, 967	1, 019, 834	6, 158, 172	3, 390	17, 720	2, 522, 985	15, 174, 859
Total	1, 542, 615	9, 330, 206	1, 025, 652	6, 231, 430	3, 390	17, 720	2, 571, 657	15, 579, 356
King, or spring:								
½-pound flat	587	8, 713	14, 249	222, 842	1, 484	26, 712	16, 320	258, 267
1-pound flat	5, 031	66, 741	14, 600	215, 026	7, 177	74, 885	26, 808	356, 652
1-pound tall	1, 382	10, 924	6, 812	57, 818	20, 785	176, 135	28, 979	244, 877
Total	7, 000	86, 378	35, 661	495, 686	29, 446	277, 732	72, 107	859, 796
Red, or sockeye:								
½-pound flat	36, 247	554, 968	38, 220	622, 898	25, 669	438, 073	100, 136	1, 615, 939
1-pound flat	24, 194	286, 724	43, 991	539, 849	7, 141	79, 761	75, 326	906, 334
1-pound tall	102, 511	1, 073, 685	371, 875	3, 773, 115	1, 040, 079	10,735,352	1, 514, 465	15, 582, 152
Total	162, 952	1, 915, 377	454, 086	4, 935, 862	1, 072, 889	11,253,186	1, 689, 927	18, 104, 425
Grand total	2, 101, 211	13,660,521	2, 084, 503	14,837,985	1, 184, 445	11,970,879	5, 370, 159	40, 469, 385

[1] Cases containing ½-pound cans have been reduced one-half in number, and thus, for the purpose of affording fair comparison, all are put upon the basis of forty-eight 1-pound cans to the case.

Output of canned salmon in Alaska, in cases, 1924 to 1929 [1]

BY SPECIES

Product or district	1924	1925	1926	1927	1928	Average for 5-year period, 1924–1928	1929	Percentage of increase or decrease in 1929, as compared with 5-year average
PRODUCT								
Coho, or silver:								
½-pound flat	8, 059	7, 145	10, 354	10, 105	13, 498	9, 832	7, 880	−19. 85
1-pound flat	5, 403	7, 223	16, 625	15, 047	5, 840	10, 028	6, 730	−32. 89
1-pound tall	170, 139	146, 642	175, 548	227, 892	279, 285	199, 901	157, 346	−21. 29
Total	183, 601	161, 010	202, 527	253, 044	298, 623	219, 761	171, 956	−21. 75
Chum, or keta:								
½-pound flat	346	3, 051	1, 367	9, 414	5, 057	3, 847	4, 961	+28. 96
1-pound flat	630		48, 982	1, 449	4	10, 213		−100. 00
1-pound tall	1, 027, 512	1, 075, 629	852, 094	496, 860	990, 724	888, 564	859, 551	−3. 27
Total	1, 028, 488	1, 078, 680	902, 443	507, 723	995, 785	902, 624	864, 512	−4. 22
Pink, or humpback:								
½-pound flat	21, 365	34, 005	59, 835	50, 455	40, 473	41, 227	44, 762	+8. 57
1-pound flat	13, 095	185	82, 161	14, 662	6, 189	23, 258	3, 910	−83. 18
1-pound tall	2, 566, 823	2, 076, 403	3, 196, 353	1, 355, 658	2, 740, 580	2, 387, 163	2, 522, 985	+5. 69
Total	2, 601, 283	2, 110, 593	3, 338, 349	1, 420, 775	2, 787, 242	2, 451, 648	2, 571, 657	+4. 90
King, or spring:								
½-pound flat	1, 501	2, 755	3, 324	10, 528	11, 782	5, 978	16, 320	+173. 00
1-pound flat	9, 500	8, 828	11, 125	11, 371	14, 854	11, 136	26, 808	+140. 73
1-pound tall	22, 647	38, 395	38, 027	48, 492	27, 523	35, 017	28, 979	−17. 24
Total	33, 648	49, 978	52, 476	70, 391	54, 159	52, 131	72, 107	+38. 32
Red, or sockeye:								
½-pound flat	31, 947	68, 901	82, 181	88, 874	89, 063	72, 193	100, 136	+38. 71
1-pound flat	110, 352	28, 757	104, 329	57, 771	87, 100	77, 662	75, 326	−3. 01
1-pound tall	1, 305, 596	962, 018	1, 970, 577	1, 173, 550	1, 771, 931	1, 436, 734	1, 514, 465	+5. 41
Total	1, 447, 895	1, 059, 676	2, 157, 087	1, 320, 195	1, 948, 094	1, 586, 589	1, 689, 927	+6. 51
Grand total	5, 294, 915	4, 459, 937	6, 652, 882	3, 572, 128	6, 083, 903	5, 212, 753	5, 370, 159	+3. 02

BY DISTRICTS AND SPECIES

Product or district	1924	1925	1926	1927	1928	Average for 5-year period, 1924–1928	1929	Percentage of increase or decrease in 1929, as compared with 5-year average
DISTRICT								
Southeast Alaska:								
Coho, or silver	109, 989	91, 352	96, 389	114, 970	145, 770	111, 694	97, 847	−12. 40
Chum, or keta	799, 557	847, 913	618, 397	224, 433	570, 219	612, 104	290, 797	−52. 49
Pink, or humpback	1, 677, 454	1, 707, 456	2, 158, 699	588, 291	2, 142, 838	1, 654, 948	1, 542, 615	−6. 79
King, or spring	8, 282	12, 005	10, 679	8, 031	5, 522	8, 904	7, 000	−21. 38
Red, or sockeye	192, 507	143, 688	173, 891	116, 468	106, 798	146, 670	162, 952	+11. 10
Total	2, 787, 789	2, 802, 414	3, 058, 055	1, 052, 193	2, 971, 147	2, 534, 320	2, 101, 211	−17. 09
Central Alaska:								
Coho, or silver	69, 180	68, 289	104, 309	138, 034	152, 360	106, 434	71, 330	−32. 98
Chum, or keta	192, 934	200, 274	243, 808	253, 197	377, 857	253, 614	497, 774	+96. 27
Pink, or humpback	892, 413	402, 992	1, 144, 180	817, 538	643, 330	780, 091	1, 025, 652	+31. 48
King, or spring	10, 531	19, 300	23, 683	43, 470	35, 036	26, 404	35, 661	+35. 06
Red, or sockeye	440, 049	361, 738	630, 505	318, 864	430, 572	436, 345	454, 086	+4. 07
Total	1, 605, 107	1, 052, 593	2, 146, 485	1, 571, 103	1, 639, 155	1, 602, 888	2, 084, 503	+30. 05
Western Alaska:								
Coho, or silver	4, 432	1, 369	1, 829	40	493	1, 633	2, 779	+70. 18
Chum, or keta	35, 997	30, 493	40, 238	30, 093	47, 709	36, 906	75, 941	+105. 77
Pink, or humpback	31, 416	145	35, 470	14, 946	1, 074	16, 610	3, 390	−79. 59
King, or spring	14, 835	18, 673	18, 114	18, 890	13, 601	16, 823	29, 446	+75. 03
Red, or sockeye	815, 339	554, 250	1, 352, 691	884, 863	1, 410, 724	1, 003, 573	1, 072, 889	+6. 91
Total	902, 019	604, 930	1, 448, 342	948, 832	1, 473, 601	1, 075, 545	1, 184, 445	+0. 83
Grand total	5, 294, 915	4, 459, 937	6, 652, 882	3, 572, 128	6, 083, 903	5, 212, 753	5, 370, 159	+3. 02

[1] The number of cases shown has been put upon the common basis of forty-eight 1-pound cans per case.

Relative importance of each species of canned salmon within each district in 1929

District	Coho	Chum	Pink	King	Red	Total, all species
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Southeast Alaska	4.7	13.8	73.4	0.3	7.8	100.0
Central Alaska	3.4	23.9	49.2	1.7	21.8	100.0
Western Alaska	0.2	6.4	0.3	2.5	90.6	100.0
All Alaska	3.2	16.1	47.9	1.3	31.5	100.0

Relative importance of each district in the production of each species of salmon canned in 1929

District	Coho	Chum	Pink	King	Red	Total, all species
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Southeast Alaska	56.9	33.6	60.0	9.7	9.6	39.1
Central Alaska	41.5	57.6	39.9	49.5	26.9	38.8
Western Alaska	1.6	8.8	0.1	40.8	63.5	22.1
Total	100.0	100.0	100.0	100.0	100.0	100.0

Average annual price per case of forty-eight 1-pound cans of salmon, 1919 to 1929

Product	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Coho, or silver	$11.27	$9.13	$5.63	$5.47	$5.74	$6.83	$9.72	$8.40	$8.51	$7.12	$7.59
Chum, or keta	6.82	4.19	3.68	3.98	4.65	4.68	4.44	5.01	5.47	6.06	5.35
Pink, or humpback	8.35	5.47	4.21	4.34	4.86	4.93	5.28	5.39	5.87	6.56	6.06
King, or spring	13.13	10.97	10.22	8.08	8.56	8.89	11.91	10.37	11.25	11.13	11.92
Red, or sockeye	12.98	13.05	8.96	9.24	9.27	9.53	13.12	9.89	12.08	9.41	10.71

PACK IN CERTAIN DISTRICTS

Statistics of the salmon pack are again presented for subdivisions of the three main districts of Alaska, and comparison is made with similar statistics for 1928. These districts are described as follows:

WESTERN ALASKA

Bristol Bay.—The Bering Sea shore, east and north of the Ugashik River.

Port Moller and Herendeen Bay.—Port Moller, Herendeen Bay, and Nelson Lagoon.

CENTRAL ALASKA

Ikatan-Shumagin Islands.—False Pass, Ikatan Bay, King Cove, and the Shumagin Islands.

Chignik.—Canneries located at Chignik.

Kodiak-Afognak Islands.—Kodiak, Spruce, and Raspberry Islands.

Cook Inlet.—The shores of Cook Inlet.

Prince William Sound.—Extends from Resurrection Bay to Point Whitshed, except that the pack of fish taken in the Copper River district by canneries at and near Cordova is omitted.

Copper and Bering Rivers.—Extends from Point Whitshed to Bering River and includes the pack by canneries at Cordova from fish not credited to Prince William Sound.

SOUTHEASTERN ALASKA

Yakutat and Dry Bay.—Extends from Yakutat Bay to and including Dry Bay.

Icy Strait-Lynn Canal—West coast of Baranof and Chichagof Islands, the shores of Cross Sound, Icy Strait, Lynn Canal, and Stephens Passage, south to Taku Harbor. Only part of the pack at Taku Harbor, as well as of those at Funter Bay and Douglas, is credited to this district, as some of the fish were taken elsewhere.

Chatham Strait-Frederick Sound.—Includes parts of the Taku, Douglas, Funter Bay, and Petersburg canneries' packs in addition to the packs of all canneries on both shores of Chatham Strait and its bays from Point Augusta to Cape Ommaney, and through Frederick Sound and its bays northward to Taku Harbor, including Kake.

Sumner Strait-Dixon Entrance.—Extends southward from Petersburg and eastward from Port Beauclerc to Cape Chacon and Dixon Entrance, and includes all canneries on the mainland and intervening islands from the Stikine River to Portland Canal. A part of the pack of the Petersburg Packing Co. is credited to this district.

West coast, Prince of Wales Island.—Territory west and south of a line from Cape Chacon to Point Baker and Cape Ommaney. A part of the Petersburg Packing Co.'s pack is credited to this district.

Pack of canned salmon in Alaska in 1929, by districts [1]

District	Coho	Chum	Pink	King	Red	Total	Percentage of increase or decrease from 1928
	Cases	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	
Bristol Bay	2,779	60,345		28,427	995,628	1,087,179	−21.95
Port Moller and Herendeen Bay		14,152		1,019	77,152	92,323	+19.89
Ikatan-Shumagin Islands	7,924	236,741	99,474	2,639	82,229	429,007	+13.79
Chignik	3,596	18,057	4,034	375	113,021	139,083	+41.05
Kodiak-Afognak Islands	13,517	103,086	338,791	802	62,577	518,773	+65.93
Cook Inlet	17,325	13,119	20,902	16,966	92,254	160,566	−20.73
Prince William Sound	7,334	128,215	565,841	257	22,080	723,727	+29.93
Copper and Bering Rivers	21,634			14,622	82,034	118,290	+24.62
Yakutat and Dry Bay	17,448	803	10,068	5,031	18,482	51,832	−12.82
Icy Strait-Lynn Canal	12,226	82,458	323,930	755	74,320	493,689	−27.93
Chatham Strait-Frederick Sound	7,422	93,256	290,303	48	16,743	407,772	−43.53
Sumner Strait-Dixon Entrance	34,192	78,976	657,582	1,048	47,575	819,373	−31.35
West coast, Prince of Wales Island	26,559	35,304	260,732	118	5,832	328,545	+5.64
Total	171,956	864,512	2,571,657	72,107	1,689,927	5,370,159	−11.73

[1] Pack reduced to the basis of forty-eight 1-pound cans per case.

MILD CURING

While the production of mild-cured salmon in 1929 was considerably less than the average for the 5-year period from 1924 to 1928, inclusive, there was an increase in the total value of the output. The fishermen in particular benefited by this increase, inasmuch as competition for the raw fish maintained prices at an unusually high level.

There were 17 plants operated, as compared with 20 in 1928. The number of fishermen, boats, and lines show a marked decrease, due principally to a change in the method of compiling the statistical data. In 1929 for the first time the bureau made an enumeration of the trolling boats operated in southeastern Alaska, including the gear and the number of fishermen employed. The total number of fishermen thus accredited to the mild-curing industry in that district in 1929 was 1,019 as compared with 1,808 in the preceding year when figures were based on estimates submitted from various sources. It is probable that a number of trolling boats may have been omitted from the enumeration this season, but a continuation of the method adopted will undoubtedly assure more accurate data than have heretofore been possible in this particular industry.

Property losses during the season included the trolling boats *Rose Marie* and *The Dream,* which were destroyed by fire; the *Ruth May,* which struck a submerged object and sank near Duke Island; and the *Aurora.*

The total output of mild-cured salmon was 4,547,200 pounds, valued at $1,241,723, a decrease of 132,800 pounds in quantity, but an increase of $139,852 in value compared with the output of the preceding season. The pack consisted of 805,600 pounds of cohos, 2,400 pounds of chums, and 3,739,200 pounds of kings. In units of 800-pound tierces the pack consisted of 1,007 tierces of cohos, 3 tierces of chums, and 4,674 tierces of kings.

Persons engaged, wages paid, and operating units, Alaska salmon mild-curing industry, 1929

Item	Southeast Alaska	Central Alaska	Total	Item	Southeast Alaska	Central Alaska	Total
PERSONS ENGAGED				OPERATING UNITS			
Fishermen:				Plants:			
Whites	807	6	813	Shore	9	1	10
Natives	206	2	208	Floating—			
Filipinos	6		6	Power vessel	1		1
				Net tonnage	24		24
Total	1,019	8	1,027	Barges	3	1	4
				Net tonnage	632	240	872
Shoresmen:				Scows	2		2
Whites	95	6	101				
Natives	9	2	11	Total plants operated	15	2	17
Total	104	8	112	Vessels:			
				Power, over 5 tons	151	2	153
Transporters:				Net tonnage	1,307	16	1,323
Whites	19		19	Launches	597	1	598
Natives	5		5	Gill net boats	6		6
Chinese	1		1	Rowboats and skiffs	90		90
				Lighters and scows	4		4
Total	25		25	Houseboat	1		1
				Apparatus:			
Grand total	1,148	16	1,164	Gill nets	4	9	13
				Fathoms	120	450	570
Wages paid shoresmen	$77,526	$3,779	$81,305	Lines	3,386	4	3,390
Wages paid transporters	$19,356		$19,356				

Products of Alaska salmon mild-curing industry in 1929

Products	Southeast Alaska		Central Alaska		Total	
	Pounds	Value	Pounds	Value	Pounds	Value
Coho, or silver	[1] 732,800	$105,126	[2] 72,800	$9,121	[3] 805,600	$114,247
Chum, or keta	2,400	198			[4] 2,400	198
King, or spring	[5] 3,583,200	1,094,823	[6] 156,000	32,455	[7] 3,739,200	1,127,278
Total	4,318,400	1,200,147	228,800	41,576	4,547,200	1,241,723

[1] 916 tierces.
[2] 91 tierces.
[3] 1,007 tierces.
[4] 3 tierces.
[5] 4,479 tierces.
[6] 195 tierces.
[7] 4,674 tierces.

PICKLING

Because of the poor runs of herring in central Alaska several individuals who had hitherto engaged in the herring business turned their attention to the salting of salmon, and the output of pickled salmon in that district was almost threefold that of the preceding year. In southeastern Alaska, also, the production showed a considerable gain. However, the shrinkage to less than half the production for 1928 in western Alaska, which is still the most important district in the salmon-pickling industry, brought the total output to the lowest level since 1925.

The number of persons reported engaged in the industry in 1929 was 96—a decrease of 44 from the previous year—while the number of plants operated decreased from 8 to 7, of which 4 were in central and 3 in western Alaska. Production in southeastern Alaska increased from 27,800 pounds in 1928 to 77,800 pounds in 1929, and in central Alaska from 92,600 pounds to 272,300 pounds. In western Alaska production decreased from 736,700 pounds in 1928 to 331,300 pounds in 1929. The total output in 1929 was 681,400 pounds, valued at $73,020; as compared with 857,100 pounds in 1928, valued at $108,637—a decrease of approximately 20 per cent in quantity and 33 per cent in value.

Persons engaged, wages paid, and operating units, Alaska salmon-pickling industry, 1929

Items	Central Alaska	Western Alaska	Total
PERSONS ENGAGED			
Fishermen:			
Whites	20	10	30
Natives	5	25	30
Total	25	35	60
Shoresmen:			
Whites	6	1	7
Natives		29	29
Total	6	30	36
Grand total	31	65	96
Wages paid shoresmen	$2,163	$5,712	$7,875
OPERATING UNITS			
Plants:			
Shore	3	3	6
Floating—			
Power vessel	1		1
Net tonnage	23		23
Total plants operated	4	3	7
Power, over 5 tons	1	2	3
Net tonnage	7	52	59
Launches	8	2	10
Gill-net boats	10	21	31
Seine skiffs	4		4
Rowboats	7	7	14
Apparatus:			
Purse seines	1		1
Fathoms	80		80
Beach seines	4		4
Fathoms	310		310
Gill nets	77	31	108
Fathoms	2,385	2,870	5,255
Wheels		4	4

Products of Alaska salmon-pickling industry in 1929

Species	Southeast Alaska		Central Alaska		Western Alaska		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Coho, or silver	33,150	$3,454	110,500	$12,082	1,000	$94	144,650	$15,630
Chum, or keta	2,300	123	600	36	14,000	982	16,900	1,141
Pink, or humpback	12,950	720	4,800	360			17,750	1,080
King, or spring	2,700	405	10,600	1,878	37,700	5,025	51,000	7,308
Red, or sockeye	26,700	3,338	145,800	21,607	278,600	22,916	451,100	47,861
Total	77,800	8,040	272,300	35,963	331,300	29,017	681,400	73,020

FRESH SALMON

The fresh-salmon business in Alaska is carried on almost entirely in the southeastern district. All operations in 1929 were incidental to other branches of the fishery industry. The total production was 1,212,012 pounds of all species valued at $110,673, against 1,646,581 pounds valued at $146,146 in 1928—a decrease of approximately 26 per cent in quantity and 24 per cent in value. Of this total, all but

FIGURE 8.—Fishermen unloading salmon on receiving scow Kvichak River, Alaska

17,000 pounds, valued at $2,300, was produced in southeastern Alaska.

Products of the Alaska fresh-salmon industry in 1929

Species	Pounds	Value
Coho, or silver	361,465	$24,918
Chum, or keta	47,638	1,564
Pink, or humpback	8,254	181
King, or spring	767,747	80,245
Red, or sockeye	26,908	3,765
Total	1,212,012	110,673

FREEZING

The production of frozen salmon in Alaska in 1929 decreased considerably from the record output of the preceding year. Operations generally were incidental to the mild curing of salmon and the freezing of halibut, although two concerns in southeastern Alaska were primarily engaged in freezing salmon, employing 19 white shoresmen. The total output in 1929 was 4,395,169 pounds, valued at $428,618, a decrease of about 29 per cent in quantity and 23 per cent in value from the production for 1928 when 6,152,743 pounds, valued at $555,308, were prepared.

Products of the Alaska frozen-salmon industry in 1929

Species	Southeast Alaska		Central Alaska		Total	
	Pounds	Value	Pounds	Value	Pounds	Value
Coho, or silver	2,160,667	$177,621	4,200	$210	2,164,867	$177,831
Chum, or keta	318,679	12,596			318,679	12,596
Pink, or humpback	72,790	2,804			72,790	2,804
King, or spring	1,838,093	235,320	680	60	1,838,773	235,380
Red, or sockeye	60	7			60	7
Total	4,390,289	428,348	4,880	270	4,395,169	428,618

DRY-SALTING, DRYING, AND SMOKING

In southeastern Alaska one company prepared dry-salted salmon, and in central Alaska two firms produced a small amount of dried salmon. These operations were incidental to other lines of business. In the fishery of the Yukon, Tanana, and Kuskokwin Rivers, which is carried on principally by natives, 1,428,600 pounds of salmon were dried, valued at $128,580, and in addition 1,800 pounds of kippered salmon, valued at $360, and 3,216 pounds of beleke, valued at $670, were prepared. In this western district 21 whites and 632 natives were engaged, and the apparatus used consisted of 242 wheels, 412 gill nets of 4,585 fathoms, 30 rowboats and skiffs, and 4 gill-net boats.

Production of dry-salted, dried, and smoked salmon in Alaska in 1929

Product	Southeast Alaska		Central Alaska		Western Alaska		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Dry salted:								
Chum, or keta	690	$41					690	$41
Pink, or humpback	2,433	124					2,433	124
Total	3,123	165					3,123	165
Dried:								
Coho, or silver			600	$60			600	60
Chum, or keta			1,600	225	1,427,000	$128,430	1,428,600	128,655
King, or spring			100	60	1,600	150	1,700	210
Total			2,300	345	1,428,600	128,580	1,430,900	128,925
Kippered: King, or spring					1,800	360	1,800	360
Beleke: King, or spring					3,216	670	3,216	670
Grand total	3,123	165	2,300	345	1,433,616	129,610	1,439,039	130,120

BY-PRODUCTS

Two companies in southeastern Alaska engaged primarily in the preparation of salmon by-products, giving employment to 19 white shoresmen and 2 white transporters. Operations incidental to other branches of the fishery industry were carried on at one herring-reduction plant and one salmon cannery in the southeastern district and at four salmon canneries in central Alaska. The total production was 1,647,170 pounds of fertilizer, valued at $41,413, and 73,975 gallons of oil, valued at $29,893, as compared with 1,421,644 pounds of fertilizer, valued at $44,109, and 42,390 gallons of oil, valued at $16,420, in 1928—an increase of approximately 16 per cent in amount of fertilizer and 75 per cent in quantity of oil.

Production of salmon oil and fertilizer in Alaska in 1929

District	Oil		Fertilizer	
	Gallons	Value	Pounds	Value
Southeast Alaska	55, 260	$20, 535	1, 245, 200	$31, 364
Central Alaska	18, 715	9, 358	401, 970	10, 049
Total	73, 975	29, 893	1, 647, 170	41, 413

HERRING

Although large schools of herring appeared from time to time during the season in Alaska, the fish in nearly all districts were generally too small for pickling. As a result, the pack of Scotch-cured herring was the smallest for any year since 1917, when this method of curing was introduced in the Territory. The output of meal and oil, however, was the largest in the history of the industry.

The one important exception to the general scarcity of herring suitable for curing was in the Aleutian Islands region, where the fishery was first exploited in 1928. The output in that district was somewhat less than in the preceding year, but it represented nearly 77 per cent of the total pack of Scotch-cured herring in Alaska, as compared with 41 per cent in 1928. While the run in 1929 was considerably lighter than in 1928, it was of longer duration, beginning early in July and continuing until the first part of September.

Because of unfavorable market conditions several companies withdrew from operations before the beginning of the season. A number of the large plants remained idle throughout the year, while some of the smaller operators turned their attention to the pickling of salmon. The only floating plants in use were the barge *Fort Union*, operated by the Port Armstrong Herring Co. in southeastern Alaska; the schooner *Rosamond*, by the North American Fisheries in the central district; and the *Alice Cooke* and the *Donna Lane*, operated by the Aurora Fish Co. and the Utopian Fisheries (Inc.), respectively, in the western district, the last-named being engaged also in the central district for a part of the season.

In southeastern Alaska, where the production of oil and meal is chiefly centered, only one operator did not pack Scotch-cured herring in connection with the manufacture of by-products. The output in most instances, however, was small. The pack of Scotch-cured herring in the southeastern district in 1929 was 1,244,250 pounds, as compared with 4,420,100 pounds in 1928, a decrease of 3,175,850 pounds; while the production of by-products increased from 18,425,424 pounds of meal and 2,303,374 gallons of oil in 1928, to 23,872,093 pounds of meal and 3,120,307 gallons of oil in 1929.

The output of Scotch-cured herring in all parts of central Alaska was negligible, the total being 200,250 pounds, valued at $13,660. The production of meal and oil, which is carried on only in the Prince

FIGURE 9.—Unloading herring, Washington Bay, southeast Alaska

William Sound area of the central district, was on about the same level as in the preceding year.

In the Aleutian Islands region the pack of Scotch-cured herring was slightly more than 5,000,000 pounds, as compared with some 6,500,000 pounds in the preceding season.

Of the 27 establishments that handled herring in southeastern Alaska, 5 were cold-storage plants that froze herring for bait, and 5 were engaged solely in the production of herring for bait. Among the larger operators engaged in the salting and reduction of herring were the following:

Reduction plant: Port Armstrong Herring Co. (floating plant)	Port Armstrong.
Saltery: Ness Fish Co	Petersburg.
Saltery and reduction plants:	
Arentsen & Co	Big Port Walter.
Atlas Packing Corporation	Deep Cove.
Buchan & Heinen Packing Co	Port Armstrong.
Chatham Strait Fish Co	New Port Walter.
Fidalgo Island Packing Co	Bay of Pillars.
Marine Packing & Reduction Co	Washington Bay.
Northwestern Herring Co	Port Conclusion.
Port Walter Herring & Packing Co	Saginaw Bay.
Storfold & Grondahl Packing Co	Washington Bay.
United States-Alaska Packing Co	Port Herbert. Warm Springs Bay.

In central Alaska operations were carried on mainly in Prince William Sound. Some packing was done in the Kodiak region, where a quantity of bait herring also was obtained, and one operator in the Chignik district put up a pack of the Scotch-cured product, but virtually no herring were taken in the Cook Inlet area. The more important operators in central Alaska were the following:

Salteries:	
Lars Hansen	Chignik.
North American Fisheries (floating plant)	Seldovia. Sitkalidak Island.
Trinity Packing Co	Three Saints Bay.
Saltery and reduction plants:	
Johnson Fisheries	Thumb Bay.
Morgan Packing Co	Port Benny.
San Juan Fishing & Packing Co	Evans Bay.
S. Sklaroff & Sons	Crab Bay.

Of the following operators in the western district, all but two were engaged in the fishery at Dutch Harbor and all produced pickled herring, chiefly Scotch-cured:

Edward Anderson	Golovin Bay.
Aurora Fish Co	Floating plant.
Broadbay Fisheries	Unalaska.
Jordon Columbus	Dutch Harbor.
Golovin Bay Packing Co	Golovin Bay.
Johnson & Peterson	Dutch Harbor.
North American Fisheries	Do.
Harry Olsen	Unalaska.
Polar Packing Co	Do.
Utopian Fisheries (Inc.)	Floating plant.

Property losses in the herring industry in 1929 totaled $22,543, consisting of seines and skiffs to the value of $8,950, damage to buildings by fire amounting to $1,593, and the loss of the gas boat *Hillside II* valued at $12,000. One fisherman was drowned.

Further investigations in connection with the study of Alaska herring, which has been in progress during the last few years, were carried on by George A. Rounsefell, scientific assistant of the bureau, and one temporary assistant.

STATISTICAL SUMMARY

The herring industry in Alaska employed 1,175 persons in 1929, as compared with 1,992 in 1928, and the number of plants decreased from 65 to 30. Products were valued at \$2,794,084, as compared with \$3,098,457 in the preceding year—a decrease of \$304,373, or about 10 per cent. Scotch-cured herring declined from 16,056,595 pounds in 1928 to 6,545,125 pounds—a decrease of 59 per cent—while herring for bait increased from 6,553,226 pounds in 1928 to 8,920,885 pounds in 1929. Meal increased 27 per cent in quantity and about 12 per cent in value, and oil increased 31 per cent in quantity and nearly 39 per cent in value over the production in 1928.

Persons engaged, wages paid, and operating units, Alaska herring industry, 1929

Item	Southeast Alaska	Central Alaska	Western Alaska	Total
PERSONS ENGAGED				
Fishermen:				
Whites	456	59	69	584
Natives			21	21
Total	456	59	90	605
Shoresmen:				
Whites	393	68	74	535
Natives			28	28
Total	393	68	102	563
Transporters:				
Whites		7		7
Grand total	849	134	192	1, 175
Wages paid shoresmen	\$225, 837	\$34, 284	\$70, 095	\$330, 216
Wages paid transporters		\$3, 600		\$3, 600
Plants:				
Shore	12	6	8	26
Floating—				
Power vessel			1	1
Net tonnage			1, 597	1, 597
Sailing vessels		1	1	2
Net tonnage		985	772	1, 757
Barge	1			1
Net tonnage	3, 300			3, 300
Total plants operated	13	7	10	30
OPERATING UNITS				
Vessels:				
Power, over 5 tons	63	9	9	81
Net tonnage	2, 045	182	228	2, 455
Launches	7	2	6	15
Gill-net boats	2		4	6
Seine skiffs	60	9	8	77
Other rowboats and skiffs	16		19	35
Lighters and scows	3		1	4
Pile driver	1			1
Apparatus:				
Purse seines	63	10	7	80
Fathoms	11, 170	1, 580	1, 155	13, 905
Beach seines		2	2	4
Fathoms		160	100	260
Gill nets			104	104
Fathoms			5, 070	5, 070
Pound seines	7	4	3	14
Pounds	9	5	6	20

Products of Alaska herring industry in 1929

Item	Southeast Alaska		Central Alaska		Western Alaska		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Fresh, for bait	4,043,990	$51,553	457,800	$6,863			4,501,790	$58,416
Frozen, for bait	4,352,495	34,729	23,600	590	43,000	$1,075	4,419,095	36,394
Frozen, for food	47,200	1,416			69,477	3,474	116,677	4,890
Pickled, for food:								
Scotch cure	1,214,250	88,609	200,250	13,660	5,100,625	425,115	6,545,125	527,384
Norwegian cure	91,165	5,703			37,400	3,500	128,565	9,203
Roused, for food (bloater stock)					149,200	7,500	149,200	7,500
Spiced	9,200	1,010					9,200	1,010
Dry salted					150,000	8,000	150,000	8,000
Meal	23,872,093	691,484	1,627,161	42,762			25,499,254	734,246
Oil	[1]23,402,303	1,316,754	[2]1,656,540	90,287			[3]25,058,843	1,407,041
Total	57,062,696	2,191,258	3,965,351	154,162	5,549,702	448,664	66,577,749	2,794,084

[1] 3,120,307 gallons. [2] 220,872 gallons. [3] 3,341,179 gallons.

HALIBUT

A light carry-over at the opening of the season and the consequent strengthening of the market led to increased effort in the halibut industry. Throughout most of the 1929 season prices were higher and the market was steadier than in the preceding year, and the total catch by the Alaska fleet showed a considerable gain. The catches of immature halibut, however, are becoming more and more out of proportion to the number of medium and large fish taken and point toward the inevitable depletion of the fishery unless more effective conservation measures are soon adopted.

No new fishing banks have been discovered, and the increase in the output of halibut in 1929 was brought about by more intensive fishing on the known banks, particularly those of the Gulf of Alaska from Yakutat westward beyond Kodiak Island. There was little tendency to extend operations to the more distant banks west of the Trinity Islands.

Bait supplies generally were adequate, several cold-storage plants in southeast Alaska putting up a considerable amount of frozen herring, while in the central district a fair quantity of bait herring was available, chiefly in the Kodiak region. The floating freezer *Donna Lane* was again operated, but only a small percentage of the bait handled was frozen, while the amount of frozen halibut prepared was much larger than in the preceding year.

Stormy weather, particularly near the beginning and close of the season, caused a heavy loss of life and property. On February 19 the *Vansee* was damaged in a gale in the Gulf of Alaska and two of the crew were carried overboard. In March a member of the crew of the schooner *Tordenskjold* was drowned. The *Kanatak* with all on board disappeared in a heavy storm on November 11, at which time also the *Sea Bird* was swept by a sea that carried away the pilot house and two men at the wheel, the vessel later being driven ashore on Wingham Island, where the survivors were picked up. Two other schooners, the *Tahoma* and *Middleton*, each lost a man overboard during the same storm. About the 1st of October the *Tyee* was found abandoned at sea, off Puffin Bay, with a large hole in the stern. It is believed that the four men of the crew were lost in attempting to make shore in a small boat. Other losses during the season included the *Roald Amundsen*, which caught fire and burned in Principe Channel early in May, and the *Corona*, which was destroyed by fire off Cape Addington on August 6. Both crews reached shore in safety. The *Commonwealth* struck a rock in the Shumagin Islands in April, but was floated later and repaired; and the *Augusta* received considerable hull damage in a collision with the gas boat *Pheasant* in Wrangell Narrows in August. The *Arona* struck a reef in Stephens Passage in September, damaging hull and propeller, and was towed to Juneau for repairs.

Life-history studies of the Pacific halibut by the International Fisheries Commission under the direction of Will F. Thompson were continued, and field work was carried on for several months during the first half of the year, the motor ship *Dorothy* again being chartered for the purpose. This work included hydrographic operations in the Gulf of Alaska, net hauls for eggs and larvæ, and the tagging of halibut in the vicinity of the Shumagin Islands. Detailed statistics of the fishery were collected, their analysis being an important step in determining an effective conservation policy.

STATISTICAL SUMMARY

There were 1,253 persons engaged in the halibut industry in 1929 an increase of 12 over the number reported for the preceding year, and the products totaled 37,456,998 pounds, valued at $4,422,605. This output represents the total fares of the Alaska halibut fleet, which comprises all American vessels landing more than one-half of their catch in Alaska or British Columbia ports rather than in the States. Landings of halibut in Alaska totaled 13,841,874 pounds, valued at $1,424,623, which include 8,000 pounds, valued at $1,000, landed by Canadian vessels. In 1928 the landings of the Alaska fleet were 31,567,000 pounds, valued at $3,094,000, while landings in Alaska totaled 9,805,000 pounds, valued at $757,000. Thus the increase in fares of the Alaska fleet was 5,889,998 pounds, or approximately 19 per cent in quantity and 43 per cent in value; while landings at Alaska ports increased 4,036,874 pounds, or about 41 per cent in quantity and 88 per cent in value from the preceding year.

Persons engaged, wages paid and operating units, Alaska halibut industry, 1929

Item	Southeast Alaska	Central Alaska	Total
PERSONS ENGAGED			
Fishermen:			
Whites	1,152		1,152
Shoresmen:			
Whites	69	15	84
Natives	14		14
Mexicans	3		3
Total	86	15	101
Grand total	1,238	15	1,253
Wages paid shoresmen	$60,823	$16,868	$77,691
OPERATING UNITS			
Vessels:			
Power, over 5 tons	169		169
Net tonnage	4,132		4,132
Launches	11		11
Dories	169		169
Skates of lines	7,150		7,150

Products of the Alaska halibut fishery in 1929

Products	Southeast Alaska		Central Alaska		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Fresh (including local)	27, 683, 371	$3, 359, 217	3, 000	$450	27, 686, 371	$3, 359, 667
Frozen	7, 988, 602	879, 655	1, 782, 025	183, 283	9, 770, 627	1, 062, 938
Total	35, 671, 973	4, 238, 872	1, 785, 025	183, 733	37, 456, 998	4, 422, 605

COD

Operations in the cod industry from shore stations in Alaska continued on about the same scale as in 1928, being carried on only by independent fishermen. There was some increase in fishing effort because of favorable market conditions, and the production showed a considerable gain. Products of the offshore fishery are

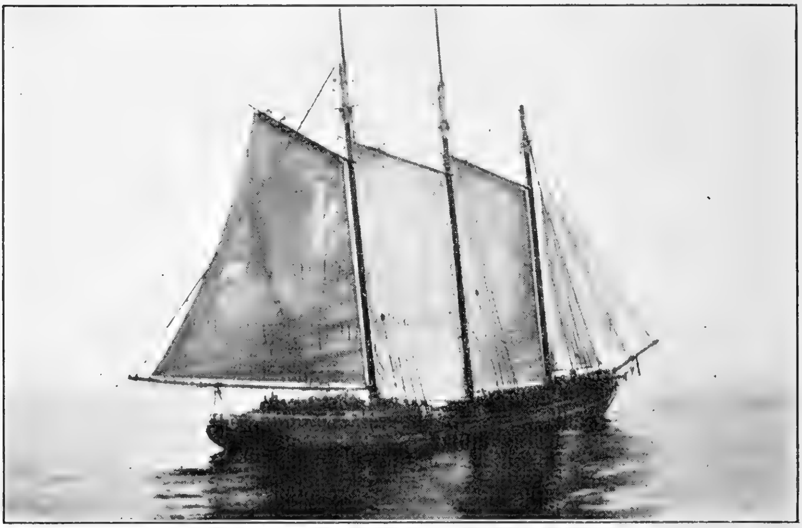

FIGURE 10.—Codfish schooner in Bering Sea

not included in the following table inasmuch as the vessels operate from and land their fares in ports of the Pacific Coast States.

The offshore fleet, which is listed below, comprised 9 vessels in all—1 belonging to Capt. J. A. Matheson, and 2 each to the Robinson Fisheries Co., Pacific Coast Codfish Co., J. E. Shields, and Union Fish Co. The Alaska Codfish Co. did not send any vessels to Alaska this year, but contracted for the catch of the *Charles R. Wilson* and *Sophie Christenson*, which were operated by J. E. Shields. The *John A* was again used in the cod industry by the Pacific Coast Codfish Co.; the *Louise*, belonging to the Union Fish Co., replaced the *Beulah;* and the *Azalea*, formerly employed by the Robinson Packing Corporation as a salmon cannery at Zachar Bay and sold to the Robinson Fisheries Co. in the fall of 1928, was added to the fleet. There was an increased use of outboard motors on fishing dories, all the vessels but one of the offshore fleet being so equipped in the 1929 season.

Of the fishermen employed in the offshore fishery, one died of disease and one was drowned. Losses of property, consisting of 3 dories and 2 anchors, amounted to $1,010, while in the shore industry the damage by storm to salt houses and the loss of certain minor items amounted to $4,080.

STATISTICAL SUMMARY

The cod industry gave employment to 67 persons in 1929, 14 more than in the preceding year. All operations were carried on in central Alaska, chiefly in the Shumagin Islands region. Dry-salted cod, stockfish, and tongues aggregating 713,838 pounds, valued at $39,756, were the products of the cod industry. Comparable figures for 1928 are 578,173 pounds, valued at $28,979. The products of the offshore fishery were reported to be 6,100,751 pounds of dry-salted cod and tongues, valued at $352,501. The offshore fishery employed 322 persons.

Persons engaged, wages paid, and operating units, Alaska cod industry, 1929

Item	Number	Item	Number
PERSONS ENGAGED		OPERATING UNITS	
Fishermen:		Shore stations	25
Whites	52	Vessels:	
Natives	4	Launches	1
		Power dories	55
Total	56	Apparatus:	
		Trawl lines	44
Shoresmen: Whites	11	Hooks	15,250
		Hand lines	91
Grand total	67		
Wages paid shoresmen	$3,031		

Products of Alaska cod industry in 1929

Item	Pounds	Value
Dry-salted cod	704,538	$38,306
Stockfish	8,700	1,370
Tongues	600	80
Total	713,838	39,756

Offshore cod fleet in 1929

Name	Rig	Net tonnage	Operator
Fanny Dutard	Schooner	252	J. A. Matheson, Anacortes, Wash.
John A.	do	235	Pacific Coast Codfish Co., Seattle, Wash.
C. A. Thayer	do	390	Do.
Azalea	do	327	Robinson Fisheries Co., Anacortes, Wash.
Wawona	do	413	Do.
Sophie Christenson	do	570	J. E. Shields, Seattle, Wash.
Charles R. Wilson	do	328	Do.
Louise	do	328	Union Fish Co., San Francisco, Calif.
William H. Smith	do	496	Do.

WHALES

The American Pacific Whaling Co. again operated its plants at Akutan and Port Hobron, using seven steam whalers during the season. Employment was given to 209 whites, 22 natives, and 2 Japanese—a total of 233 and an increase of 3 over the number reported employed in the industry in 1928. One fisherman lost his life by drowning. The company took 385 whales in all, consisting of 105 finbacks, 214 humpbacks, 53 sulphur bottoms, 12 sperm, and 1 right whale. This is a decrease of 17 from the number caught in Alaskan waters in the preceding year.

The products of the whale fishery were as follows: 785,700 gallons of whale oil, valued at $413,391; 47,750 gallons of sperm oil, valued at $17,800; 836 tons of fertilizer from meat, valued at $54,340; 475 tons of bone fertilizer, valued at $14,250; 36,314 pounds of pickled meat, valued at $1,500; and 16,000 pounds of whalebone, valued at $800—a total value of products of $502,081 and an increase of about 11 per cent over 1928 when products were valued at $454,274.

CLAMS

The production of clams in Alaska, which had been decreasing steadily since the record output of 1924, showed a decided upward trend this year. The bulk of the pack was prepared by two firms that were engaged also in canning salmon—the Pioneer Packing Co. at Cordova and the Seashore Packing Co. at Kukak Bay—while six other operators produced a small amount. All operations were in central Alaska, principally in the Cordova district.

Employment was given to 180 whites, and the output was 28,001 cases containing 704,448 pounds, valued at $203,656, an increase of approximately 92 per cent in quantity and 90 per cent in value over the production in 1928, when 15,170 cases totaling 367,494 pounds, valued at $107,046, were packed.

Products of the Alaska clam industry in 1929

Item	Cases	Pounds	Value
Minced:			
½-pound cans (48 to case)	23,699	568,776	$170,785
10-ounce cans (48 to case)	3,612	108,360	26,808
20-ounce cans (24 to case)	293	8,790	1,886
Whole:			
½-pound cans (48 to case)	20	480	148
10-ounce cans (48 to case)	2	60	22
1-pound cans (48 to case)	374	17,952	4,001
Juice, 10-ounce cans (48 to case)	1	30	6
Total	28,001	704,448	203,656

SHRIMP

No new developments occurred in the shrimp industry in 1929, the grounds fished being the same as in the preceding year, with no additional gear in use. Two plants were again operated, one by the Alaska Glacier Sea Food Co. at Petersburg and one by the Reliance Shrimp Co. at Wrangell. Fishing during the fall months was curtailed somewhat because of a slump in the market, but the total production for the season was almost equal to that for 1928.

Employment was given to 107 persons, of whom 15 were whites, 48 natives, 26 Japanese, 11 Filipinos, 6 Mexicans, and 1 Chinese. Products for the 1929 season consisted of 497,750 pounds of shrimp meat valued at $200,312, a decrease of 6,521 pounds in quantity and $1,853 in value from the preceding year, when 504,271 pounds valued at $202,165 were prepared.

CRABS

In southeastern Alaska crab products were prepared by two companies—the Northern Sea Food Co. at Petersburg and the Reliance Shrimp Co. at Wrangell, the latter being engaged chiefly in the handling of shrimp. The Northern Sea Food Co. operated also in central Alaska at Cordova. There were 44 persons employed in the industry, of whom 40 were whites and 4 Filipinos. Products consisted of 188,119 pounds of cold-packed meat, valued at $71,383, and 862 dozen crabs in the shell, valued at $1,482. The total value of products in 1929 was $72,865, as compared with $51,477 in 1928—an increase of almost 42 per cent.

TROUT

Production of trout in Alaska in 1929 was incidental to other fishery operations. The products were as follows: Dolly Vardens, 35,500 pounds fresh valued at $5,591, 22,976 pounds frozen valued at $2,054, and 192 pounds canned valued at $20; steelheads, 13,240 pounds fresh valued at $1,612 and 25,217 pounds frozen valued at $1,982. The total production of both species was 97,125 pounds valued at $11,259, as compared with 55,896 pounds valued at $6,405 in 1928—an increase of 74 per cent in quantity and 76 per cent in value.

MISCELLANEOUS FISHERY PRODUCTS

Several species of fish of minor commercial importance are taken in small quantities, chiefly in connection with the halibut fishery, and are landed at ports of Alaska and British Columbia and at Seattle. Such products landed in southeastern Alaska in 1929 were as follows: Sablefish, 4,321 pounds fresh valued at $157, 462,174 pounds frozen valued at $22,129, and 5,600 pounds pickled valued at $420; rockfishes, 460 pounds fresh valued at $9; "lingcod," 13,400 pounds fresh valued at $316 and 26,398 pounds frozen valued at $792; smelt, 3,880 pounds fresh valued at $392 and 1,286 pounds frozen valued at $141.

FUR-SEAL INDUSTRY

PRIBILOF ISLANDS

GENERAL ADMINISTRATIVE WORK

In the calendar year 1929, 40,068 fur-seal skins were taken on the Pribilof Islands, of which 33,216 were secured on St. Paul Island and 6,852 on St. George Island. The take from both islands was 8,969 greater than the take in 1928, and greater than in any year since 1889. Of the total number of fur seals killed in 1929, 38,845 were 3-year-old males. Eight thousand and eighty-five 3-year-old males were marked and released to provide for the future breeding stock. The blue-fox herds on St. Paul and St. George Islands were maintained in normal condition, and in the foxing season of 1929–30, 745 blue pelts and 32 white pelts were obtained.

Several new buildings for the use of the natives and for work connected with general sealing operations were constructed. The building of roads was continued.

Through the courtesy of the Navy Department the U. S. S. *Sirius* transported from Seattle the general annual shipment of supplies required at the Pribilof Islands and on the bureau's power schooner *Eider*. Valuable assistance was rendered also by vessels of the United States Coast Guard, which maintained a patrol of waters frequented by the fur seals and performed many services in connection with the bureau's work at the islands.

The practice of retaining and selling the Canadian and Japanese Governments' shares of fur-seal skins taken at the Pribilof Islands and then remitting to those Governments their respective shares of the proceeds was continued. The North Pacific Sealing Convention of July 7, 1911, contemplated a physical delivery of skins at the Pribilof Islands to the Governments in question, but subsequent arrangements provided that the United States sell all of the skins and make proportionate distribution of the proceeds. The United States' share of fur-seal skins, 170 in number, taken under the jurisdiction of Japan in 1929 were received at St. Louis in January, 1930.

PURCHASE AND TRANSPORTATION OF SUPPLIES

The U. S. S. *Sirius* transported the general supplies required for the Pribilof Islands and for the power schooner *Eider*. The *Sirius* left Seattle with the cargo on July 26 and arrived at the Pribilofs on August 5. En route the vessel discharged at Dutch Harbor 17 tons of supplies and 25 tons of coal for the *Eider*. The cargo for the Pribilofs consisted of approximately 1,075 tons of general supplies, 1,040 tons of coal, and 700,000 feet of lumber. The vessel left the islands on September 7 with the season's shipment of fur-seal and fox skins, some miscellaneous freight, and a number of passengers, arriving at Seattle September 16.

The work of discharging cargo and taking aboard the annual shipment of fur-seal and fox skins was greatly hindered by heavy weather.

Minor shipments of supplies were made from Seattle from time to time. Some were taken by the *Eider* on its departure from Seattle in March. A shipment amounting to approximately 24 tons, consisting chiefly of perishable foodstuffs for the Pribilofs and the *Eider*, was forwarded from Seattle on the steamship *Victoria* on May 14 for delivery to the *Eider* at Akutan. Another small shipment was made from Seattle on the *Victoria* on June 5, delivery being made to the *Eider* at Dutch Harbor. The usual fall shipment of perishable foodstuffs and miscellaneous emergency supplies for the Pribilof Islands, approximately 50 tons, was forwarded to Dutch Harbor from Seattle on September 13 on the *Tanana*. The fall shipment was forwarded earlier this year on account of an accident to the *Eider* which made it necessary to arrange for the transfer of the supplies from Dutch Harbor to the Pribilofs by a U. S. Coast Guard cutter before the last one left the region for the season. The transfer was effected by the cutter *Northland*.

POWER SCHOONER "EIDER"

From the beginning of the year until its departure for Unalaska and the Pribilof Islands on March 18, the *Eider* was at Lake Union Dry Dock, Seattle, Wash., where a general overhauling was given the engine, hull, and equipment. En route to Unalaska the vessel called at Ketchikan and Seward for fuel, arriving at Unalaska on April 1. Two days later it sailed for the Pribilof Islands, arriving there on the 4th with the first mail of the season. On this trip transportation was furnished to a dentist and three carpenters from Seattle to St. Paul Island.

The *Eider* left the islands on April 5 with Dr. Wallace H. Carver and family as passengers, transferring them to the *Catherine D* at King Cove. From the 15th to the 25th the *Eider* called at various native villages along the Alaska Peninsula, where investigations were made of the available labor supply for the Pribilofs. The vessel received from the S. S. *Lakina* at False Pass on April 25 passengers and freight for the Pribilof Islands and left the same day, but on account of heavy weather was forced to proceed to Unalaska. There two of the passengers were transferred to the U. S. Coast Guard cutter *Chelan.* The *Eider* left Unalaska on the 28th with the other passengers and freight, returning to that port after landing them at the islands.

In May two trips were made to the islands with mail, passengers, and miscellaneous freight. In June similar work was carried on between Unalaska and near-by ports and the islands. Some inter-island work was accomplished.

In addition to the regular island service during July, the *Eider* rendered assistance in connection with the annual seal computation. On July 25 the vessel left St. Paul Island with employees and other passengers to connect with an outgoing steamer at Akutan.

During August and until September 7 the *Eider* was at the Pribilof Islands while the annual supplies were being unloaded from the U. S. S. *Sirius.* Because of extremely rough weather this work required a considerably longer time than usual.

On September 8 the *Eider* was driven off her course in a heavy gale and struck a reef on the north shore of St. George Island, thereby being disabled for further service until repaired. The next day the vessel was taken in tow by a United States Coast Guard cutter and was towed to Seattle, where it arrived on September 26.

On October 9 the vessel was moved from Lake Union to the Ballard Marine Ways, where repairs were made. The *Eider* returned to Lake Union on October 26 and remained there through the remainder of the year.

During the year the *Eider* traveled under her own power 9,122 nautical miles, using 8,056 gallons of fuel while running.

The *Eider* will be used hereafter in patrol work in the Alaska fisheries service, its former duty in the fur-seal service being taken over by the new power vessel *Penguin.*

POWER VESSEL "PENGUIN"

The new power vessel *Penguin*, which is to replace the *Eider* as local tender for the Pribilof Islands, was launched from the ways of the Ballard Marine Railway Co., Seattle, Wash., on January 8, 1930. It is the largest of the bureau's Alaska vessels, being 130 feet in length and 27 feet in breadth, with a molded depth of 17 feet 10 inches.

The *Penguin* is of very substantial construction and is sheathed for protection against the drifting ice so often encountered in Bering Sea during the spring. In addition to ample quarters for officers and crew, comfortable accommodations have been provided for a number of bureau employees. Space has also been provided for the transportation of temporary native workmen engaged for duty at the islands. The hold, which is provided with an intermediate deck, will accommodate 160 tons of cargo. The main power plant is a 400-horsepower Union full Diesel engine, giving a normal cruising speed of about 10 knots. The vessel is provided throughout with complete modern equipment. Fuel tanks give a normal cruising radius of approximately 4,000 miles.

ROADS

St. Paul Island.—During the brief period between the time when the ground became sufficiently thawed to permit operations and the beginning of the sealing season, practically one-half mile of new road was surfaced. This section of road extended from the Halfway Point Bridge to the Halfway Point killing field, and made a total of 5½ miles of scoria-surfaced road between the village and Northeast Point. Later, a little over one mile of roadbed was made through the sand along Big Lake. On account of the sand this section of the Northeast Point road will have to be laid with plank tracks before it can be used by motor trucks. Lumber sufficient to lay tracks over about 3 miles of road across sand was sent to St. Paul Island in the year and hauled to the vicinity of Big Lake. It is planned to lay it in 1930.

St. George Island.—Lumber for tracking a mile of roadway was shipped to the island. The most of it was hauled to places where it will be required on the North Rookery road. Considerable ditching was undertaken on this road in the year. Road work was delayed by the late departure of the supply vessel.

BUILDINGS

St. Paul Island.—A new building was constructed at Northeast Point for use as a bunk house for natives. It is of frame construction on a concrete foundation and contains a kitchen, mess room, and sleeping quarters for 50 persons.

The work on two 3-room concrete houses for natives, foundations for which had been poured in 1928, was carried far enough along to permit completion in the winter of 1929–30.

Concrete basement walls were poured for a hospital. Above the basement the building will be of frame construction. A school building of sufficient size to accommodate all the pupils was built. In the past the children have been cared for in two buildings no longer possible of repair. The building is of frame construction with a concrete basement fitted for manual training and the teaching of domestic science.

Other buildings constructed during the year were a coal house, a cold storage, and a small frame building to house the electric refrigeration engine and compression equipment used in connection with the employees' mess.

The natives built a 4-room dwelling for the resident priest. Labor and material for the structure were furnished by the natives, and the building is the property of the natives' church.

St. George Island.—The medical building begun in 1928 was completed. On the first floor it has living quarters for the resident physician and his family, an office, a dispensary, and a small operating room. On the second floor there are two rooms for patients, a bathroom, and a dental operating room.

In the course of the year the building of two 5-room, two 4-room, and two 3-room houses, all for natives, was begun. It was planned to complete these buildings in the winter of 1929–30.

The salt house was altered so as to provide for more kenches for the salting of fur-seal skins. A new store was built, the building being a 2-story structure of which the second floor is to be used for

FIGURE 11.—New concrete residences for natives, St. Paul Island, Alaska

the storage of supplies. A shelter shed for cattle and a small smokehouse were also built.

BY-PRODUCTS PLANT

The by-products plant on St. Paul Island was not operated in 1929, as sufficient materials were on hand to provide fox feed and take care of other requirements. Plans are under way for the construction of a new plant which will be provided with modern equipment. This will enable an improved quality of output and provide for more effective and profitable utilization of the seal carcasses available for reduction purposes.

NATIVES

CENSUS

The annual census, taken as of December 31, 1929, showed 215 native residents on St. Paul Island. In addition, four St. Paul Island natives were in the States enrolled at the Salem Indian School, Chemawa, Oreg., and five elsewhere, making a total of 224 accredited to the island. Four natives were recorded as having permanently left the island and five, of whom four were from St. George Island, as having become permanent residents of St. Paul Island. One native who left the island in November, 1927, and was carried subsequently among those temporarily absent, has been dropped from the census list, inasmuch as nothing is known concerning his intentions of returning to the island. During the year there were 9 births and 6 deaths among the natives, including the death of 1 who was temporarily absent from the island.

On St. George Island there were 144 native residents as of December 31, 1929. Five natives left the island during the year and settled elsewhere, four of them becoming permanent residents of St. Paul Island. There were four births and two deaths on St. George Island in 1929.

The total number accredited to both islands on December 31, 1929, was 368, the same number as at the close of the preceding year.

MEDICAL SERVICES

For the benefit of the native population and Government employees and their families at the Pribilof Islands, medical aid is provided by the bureau. Two physicians were stationed at the islands throughout the year, and a dentist was on duty there from the beginning of April until the first of September. Health conditions, in general, were good on both islands.

SCHOOLS

Schools for the native children are maintained on both St. Paul and St. George Islands. Two teachers are employed on each island.

St. Paul Island.—The 1928–29 school year began September 10, 1928, and closed on May 10, 1929. There were 31 children enrolled in the junior school and 31 in the senior school, a total of 62 children.

St. George Island.—The school year began on September 17, 1928, and ended on May 31, 1929. In the senior school 10 boys and 12 girls were enrolled, and in the junior school 11 boys and 7 girls, a total of 40 children.

ATTENDANCE AT SALEM INDIAN SCHOOL, CHEMAWA, OREG.

There were no additions to the enrollment of Pribilof Islands native children at the Salem Indian School, Chemawa, Oreg., in 1929. The four (Mariamna Merculieff, Kleopatra Krukoff, Tatiana Krukoff, and Abraham S. Merculieff) who were under enrollment at the beginning of the year remained at the school, with the exception of Tatiana Krukoff, who was released in the summer and was reported in February, 1930, to be working in Portland, Oreg.

STORES

In recent years the natives of the Pribilofs have been operating a store on St. Paul Island and another on St. George Island on funds provided by themselves. The first store was started in an experimental way, but the results obtained indicate permanent success for the undertaking.

The natives themselves manage the business and make the sales. The bureau's agents advise the natives and assist in the preparation of orders for new stock and in its purchase. Food, clothing, tobacco, toilet articles, and other supplies are handled. Most of the supplies are of a kind or grade not furnished by the bureau for the natives.

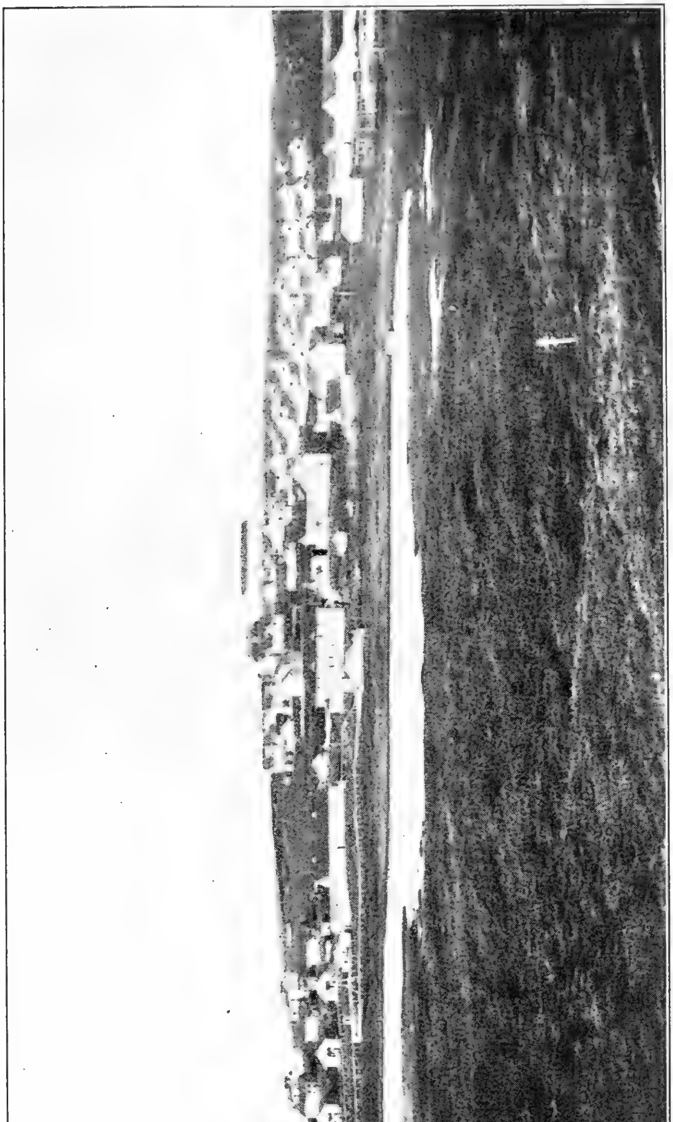

FIGURE 12.—Village on St. Paul Island in 1929

Since the natives receive a part of their compensation for sealing and foxing work in cash, it naturally follows that they wish to spend a part of it for supplies especially desired by them and not otherwise available. Before the natives' stores were established, purchases could only be made at infrequent intervals and shipments were usually received in bulk. Receipts of supplies in large quantities by individuals usually resulted in heavy consumption for a comparatively brief period followed by a scarcity for a longer period before new supplies could be purchased and delivered. The advent of the stores made it possible for individuals to purchase a variety of articles in small amounts and as needed. This is a far more satisfactory method.

Sales to others than natives of the Pribilof Islands are prohibited or restricted, to the end that the stores shall be of maximum benefit to the resident natives.

SAVINGS ACCOUNTS

Certain of the Pribilof Islands natives and the St. Paul Island native church have funds in the custody of the United States Commissioner of Fisheries. Throughout 1929 these funds were kept on deposit with the Washington Loan & Trust Co., Washington, D. C., and interest was paid at the rate of 3 per cent per annum, calculated on monthly balances. Two new accounts for natives were opened, and 12 accounts were closed during the year. These include an account that was opened and closed during the year. A summary of the accounts as a whole for the year 1929 is shown in the statement that follows:

On hand, Jan. 1, 1929	$10,942.50
Interest earned from Jan. 1 to Dec. 31, 1929	307.81
	11,250.31
Withdrawn by natives and native church in 1929	1,677.23
On hand, Dec. 31, 1929	9,573.08

An itemized statement of the funds, showing the individual accounts, follows:

Funds of the Pribilof Islands natives and the St. Paul Island native church in the custody of the United States Commissioner of Fisheries, as trustee, December 31, 1929

Bourdukofsky, Martha	$118.07
Fratis, Iuliania [3]	121.35
Gromoff, Iuliania	332.72
Kochutin, Alexandra	3,989.04
Kozloff, Raisa	104.89
Lekanof, Sophia M	77.58
Lestenkof, Michael	353.58
Merculieff, Mariamna [3]	84.13
Merculief, Alexandra	246.90
Merculief, Daniel	631.83
Merculief, Erena	631.84
Merculief, George	$224.22
Merculief, jr., George	122.97
Merculief, Nicolai G	73.91
Merculief, Tatiana	631.84
Pankoff, Agrippina	171.36
St. Paul Island native church	1,419.48
Sedick, Lavrenty	125.13
Shane, Marina [4]	111.79
Zacharof, Emanuel [5]	.45
Total	9,573.08

PAYMENTS FOR TAKING FUR-SEAL SKINS

The resident natives of the Pribilof Islands were paid in cash for their work in taking sealskins. A flat rate of 75 cents was allowed for each sealskin taken, and bonuses were allowed for special work. As

[3] Not living on Pribilof Islands in 1929.
[4] New account.
[5] Deceased.

the work of taking sealskins is collective in character, the amount earned on each island, on the basis of 75 cents per skin, was divided among the resident native sealers in accordance with ratings based on skill and ability. The men were divided into classes, each man in a given class receiving an equal amount. Payments were made as shown below:

St. Paul Island.—For the 33,216 sealskins taken on St. Paul Island $24,912 was paid and, in addition, $100 was allowed two foremen for special services and $50 for a cook. A statement of the earnings follows:

Payments to St. Paul Island natives for taking fur-seal skins, calendar year 1929

Classification	Number of men	Share of each	Total	Classification	Number of men	Share of each	Total
First class	33	$498.00	$16,434.00	Foreman (additional compensation)			$60.00
Second class	13	396.75	5,157.75	Do			40.00
Third class	6	300.00	1,800.00	Cook			50.00
Fourth class	5	200.25	1,001.25				
Fifth class	2	187.50	375.00				
Do	3	48.00	144.00	Total			25,062.00

St. George Island.—For the 6,852 sealskins taken on St. George Island $5,139 was paid and, in addition, a total of $100 was allowed two foremen for special services. A statement of the earnings follows:

Payments to St. George Island natives for taking fur-seal skins, calendar year 1929

Classification	Number of men	Share of each	Total	Classification	Number of men	Share of each	Total
First class	1	$185.25	$185.25	Fifth class	4	$32.25	$129.00
Do	21	171.75	3,606.75	Foreman (additional compensation)			55.00
Second class	5	131.25	656.25	Do			45.00
Third class	4	97.50	390.00				
Fourth class	2	66.00	132.00				
Fifth class	1	39.75	39.75	Total			5,239.00

PAYMENTS FOR TAKING FOX SKINS

The natives are paid $5 in cash for each fox skin taken on the Pribilof Islands. For the season of 1928–29 these payments amounted to $435 for the 87 skins taken on St. Paul Island and $2,330 for the 466 skins taken on St. George Island, a total of $2,765.

FUR SEALS

QUOTAS FOR KILLING AND RESERVING

The plans approved by the department for sealing operations in 1929 provided for reserving eight thousand 3-year-old male fur seals for future breeding stock and to kill as many of the remaining 3-year-old males as were available. The animals for the reserve were to be selected in approximately the ratio of 4 on St. Paul Island to 1 on St. George Island and were to be marked so as to insure their immunity from slaughter throughout the period of sealing operations. Provi-

FIGURE 13.—Fur seals on St. Paul Island Alaska

sion was made for increasing the reserve if the idle and harem bull counts made in the breeding season indicated the need of a larger one. Since some of the 3-year-old males are never taken up in either the killing drives or the drives for marking reserves, the number of animals remaining for the reserve is always greater than the number marked.

KILLINGS

In 1929, 40,068 fur seals were killed, of which 33,216 were taken on St. Paul Island and 6,852 on St. George Island. These figures include 800 killed in the fall for food for the natives. Details in regard to the killings are shown in the following tabulations:

Seal killings on Pribilof Islands in 1929

ST. PAUL ISLAND

Date	Serial No. of drive	Hauling ground	Skins secured	Date	Serial No. of drive	Hauling ground	Skins secured
June 8	1	Reef and Gorbatch	132	7	24	Reef and Gorbatch	3,077
13	2	Tolstoi, Lukanin, and Kitovi	87	8	25	Polovina, Polovina Cliffs, and Little Polovina	686
14	3	Zapadni and Little Zapadni	97	9	26	Vostochni and Morjovi	1,759
15	4	Reef and Gorbatch	617	10	27	Tolstoi, Lukanin, and Kitovi	691
17	5	Polovina and Little Polovina	130	11	28	Zapadni and Little Zapadni	560
18	6	Vostochni and Morjovi	512	12	29	Reef and Gorbatch	2,690
19	7	Tolstoi, Lukanin, and Kitovi	101	13	30	Polovina, Polovina Cliffs, and Little Polovina	433
20	8	Zapadni and Little Zapadni	318	14	31	Vostochni and Morjovi	1,587
21	9	Reef and Gorbatch	1,235	15	32	Tolstoi, Lukanin, and Kitovi	683
22	10	Polovina, Polovina Cliffs, and Little Polovina	59	16	33	Zapadni and Little Zapadni	355
23	11	Vostochni and Morjovi	732	17	34	Reef and Gorbatch	624
24	12	Tolstoi, Lukanin, and Kitovi	235	18	35	Polovina, Polovina Cliffs, and Little Polovina	229
25	13	Zapadni and Little Zapadni	457	19	36	Vostochni and Morjovi	691
26	14	Reef and Gorbatch	1,619	20	37	Tolstoi, Lukanin, and Kitovi	567
27	15	Polovina, Polovina Cliffs, and Little Polovina	482	21	38	Reef and Gorbatch	1,536
28	16	Vostochni and Morjovi	1,465	22	39	Zapadni and Little Zapadni	629
29	17	Tolstoi, Lukanin, and Kitovi	410	23	40	Polovina, Polovina Cliffs, and Little Polovina	277
30	18	Zapadni and Little Zapadni	650	26	41	Gorbatch	15
July 1	19	Reef and Gorbatch	1,853	Oct. 21	42	do	166
2	20	Polovina, Polovina Cliffs, and Little Polovina	630	25	43	Tolstoi	121
3	21	Vostochni and Morjovi	1,530	28	44	Gorbatch	52
5	22	Tolstoi, Lukanin, and Kitovi	951	Nov. 1	45	Polovina	37
6	23	Zapadni and Little Zapadni	1,325	6	46	Gorbatch	124
						Total	33,216

ST. GEORGE ISLAND

Date	Serial No. of drive	Hauling ground	Skins secured	Date	Serial No. of drive	Hauling ground	Skins secured
June 5	1	North	32	July 4	19	North and Staraya Artil	514
10	2	East	36	6	20	Zapadni	129
11	3	North	80	7	21	East	398
12	4	Zapadni	42	8	22	North and Staraya Artil	659
15	5	East	24	10	23	Zapadni	73
17	6	North	120	11	24	East	288
18	7	Zapadni	32	12	25	North and Staraya Artil	505
20	8	East	108	15	26	East	105
21	9	North	126	16	27	North and Staraya Artil	455
21	10	Staraya Artil	92	19	28	East	337
24	11	Zapadni	23	20	29	North and Staraya Artil	630
25	12	East	127	23	30	East	155
26	13	North and Staraya Artil	486	Oct. 21	31	North	195
28	14	Zapadni	50	30	32	do	39
29	15	East	267	Nov. 4	33	do	44
30	16	North and Staraya Artil	384	18	34	do	22
July 2	17	Zapadni	49				
3	18	East	226			Total	6,852

AGE CLASSES

The age class of a male seal belonging to the Pribilof Islands herd is determined from the length of its body. The classification was derived from measurements of a large number of pups branded in 1912 and killed in subsequent years. The limits of the various age classes are shown in the table following:

Age classes of male seals, Pribilof Islands

Age	Length of summer seals	Length of fall seals	Age	Length of summer seals	Length of fall seals
	Inches	*Inches*		*Inches*	*Inches*
Yearlings	Up to 36.75	Up to 38.75	4-year-olds	46 to 51.75	48 to 53.75
2-year-olds	37 to 40.75	39 to 42.75	5-year-olds	52 to 57.75	54 to 59.75
3-year-olds	41 to 45.75	43 to 47.75	6-year-olds	58 to 63.75	60 to 65.75

Ages of seals killed on Pribilof Islands, calendar year 1929

[On basis of classification shown in preceding table]

Age	Summer (Jan. 1 to Aug. 5)			Fall (Aug. 6 to Dec. 31)			Total for year		
	St. Paul	St. George	Total	St. Paul	St. George	Total	St. Paul	St. George	Total
Yearling males	37		37				37		37
2-year-old males	781	69	850	23	10	33	804	79	883
3-year-old males	31,635	6,444	38,079	477	289	766	32,112	6,733	38,845
4-year-old males	219	35	254				219	35	254
5-year-old males	2		2				2		2
6-year-old males	2		2				2		2
Cows [1]	40	4	44		1	1	40	5	45
Total	32,716	6,552	39,268	500	300	800	33,216	6,852	40,068

[1] Cows accidentally and unavoidably killed.

It should be stated that some of the seals recorded in the above tabulation as 2-year-olds or 4-year-olds probably were 3-year-olds. Not all the male seals of a given age fall within the length limits assigned for the males of that age. As far as possible the killings in 1929 were confined to 3-year-old males.

RESERVING OPERATIONS

Since the killing of fur seals at the Pribilof Islands is confined as far as possible to 3-year-old males, the reservation of males of this age practically insures their protection from killing operations. In 1929, 8,085 3-year-old males were marked for the reserve by shearing a patch of fur. The number marked on St. Paul Island was 6,430, and on St. George Island 1,655. Two hundred of those sheared on St. Paul Island were also branded with a hot iron for special observation later.

Marking of 3-year-old male fur seals for breeding reserve, Pribilof Islands, 1929

ST. PAUL ISLAND

Date	Hauling ground driven	Number of seals marked
July 24	Vostochni and Morjovi	597
25	Tolstoi and Lukanin	272
26	Gorbatch	1,061
27	Reef and Gorbatch	943
28	Zapadni	640
29	Polovina, Polovina Cliffs, and Little Polovina	227
29	Vostochni and Morjovi	1,835
31	Reef and Gorbatch	855
	Total	6,430

ST. GEORGE ISLAND

Date	Hauling ground driven	Number of seals marked
July 18	Zapadni	76
22	do	53
24	North and Staraya Artil	338
25	East	234
26	Zapadni	48
27	North and Staraya Artil	506
29	East	400
	Total	1,655

COMPUTATION OF FUR-SEAL HERD

A continued satisfactory growth in the size of the Pribilof Islands fur-seal herd was shown in 1929. As of August 10 the total of all classes was 971,527—a numerical increase of 100,014 and a percentage increase of 11.48 over the figures for the preceding year. The computation was again made by Supt. H. J. Christoffers, who was assisted by A. Christoffersen, H. A. Peterson, and A. J. Messner. The detailed report will be found on pages 334 to 339 of this document. Following is a comparative statement of the numerical strength of the various elements of the fur-seal herd in the years 1918 to 1929, inclusive:

General comparison of computations of the seal herd on the Pribilof Islands, 1918 to 1929

Class	1918	1919	1920	1921	1922	1923
Harem bulls	5,344	5,158	4,066	3,909	3,562	3,412
Breeding cows	142,915	157,172	167,527	176,655	185,914	197,659
Surplus bulls	17,110	9,619	6,115	3,301	2,346	1,891
Idle bulls	2,444	2,239	1,161	747	508	312
6-year-old males	13,755	8,991	4,153	3,991	3,771	4,863
5-year-old males	11,941	5,282	5,007	4,729	6,080	10,612
4-year-old males	7,114	5,747	5,667	6,780	11,807	5,710
3-year-old males	9,117	13,596	10,749	14,668	7,459	22,786
2-year-old males	30,159	33,081	39,111	41,893	40,920	43,112
Yearling males	41,595	46,444	51,074	50,249	52,988	55,769
2-year-old cows	30,415	33,287	39,480	43,419	46,280	48,801
Yearling cows	41,608	46,447	51,081	54,447	57,413	60,422
Pups	142,915	157,172	167,527	176,655	185,914	197,659
Total	496,432	524,235	552,718	581,443	604,962	653,008

c mparison of computations of the seal herd on the Pribilof Islands, 1918 to 1929—Continued

Class	1924	1925	1926	1927	1928	1929
Harem bulls	3, 516	3, 526	4, 034	4, 643	6, 050	7, 187
Breeding cows	208, 396	226, 090	244, 114	263, 566	284, 725	307, 491
Surplus bulls	2, 043	3, 558	2, 002	4, 827	5, 285	5, 207
Idle bulls	390	311	423	972	1, 449	1, 633
6-year-old males	8, 489	4, 105	13, 434	13, 450	12, 857	10, 399
5-year-old males	5, 132	16, 792	16, 812	16, 073	13, 001	7, 016
4-year-old males	18, 670	18, 692	17, 872	14, 448	7, 798	9, 102
3-year-old males	21, 551	21, 185	17, 189	9, 730	11, 133	13, 639
2-year-old males	45, 685	43, 515	38, 183	41, 252	49, 087	64, 354
Yearling males	59, 291	52, 091	56, 514	61, 026	65, 861	85, 381
2-year-old cows	51, 359	49, 786	44, 415	48, 186	57, 061	67, 210
Yearling cows	64, 249	57, 309	62, 175	67, 131	72, 481	85, 417
Pups	208, 396	226, 090	244, 114	263, 566	284, 725	307, 491
Total	697, 158	723, 050	761, 281	808, 870	871, 513	971, 527

FOXES

On both St. Paul Island and St. George Island attention is given to the care of a herd of blue foxes. Throughout the summer the animals find an abundance of natural food, consisting of fur-seal carcasses, birds' eggs, and marine life along the beaches. In the winter season they are fed preserved seal meat and prepared rations. Captures are made at that time for obtaining the pelts or for marking and releasing the animals for breeding stock. The natives perform this work under the direction of the bureau's resident staff and receive $5 for each fox skin taken. The skins are shipped to the Fouke Fur Co. at St. Louis, Mo., where they are sold at public auction for Government account.

TRAPPING SEASON OF 1929-30

During the season of 1929–30, 745 blue and 32 white fox pelts were taken, a total of 777. Of this number, 193 blue and 31 white pelts were taken on St. Paul Island and 552 blue pelts and 1 white pelt on St. George Island. There were also trapped, marked, and released for breeding purposes 72 foxes on St. Paul Island and 546 on St. George Island. The breeding reserve includes, in addition, a number of animals that are not captured during the foxing season.

REINDEER

St. Paul Island.—During the year ended September 30, 1929, 20 reindeer were killed and used for food. A count of the animals in the herd on September 27 showed a total of 329, of which 25 were the young of the season. The herd was reported to be in good condition.

St. George Island.—No reindeer were killed for food in the year ended September 30, 1929. When the count was made at the end of that period there were 45 animals in the herd and no young whatever were observed.

FUR-SEAL SKINS

SHIPMENTS

One shipment of fur-seal skins was made from the Pribilof Islands in the calendar year 1929. This consisted of 40,067 skins, as follows: From St. Paul Island, 501 taken in the calendar year 1928 and 32,714 taken in 1929; from St. George Island, 300 taken in the calendar year 1928 and 6,552 taken in 1929. The shipment was made from the islands in September on the U. S. S. *Sirius*, which arrived at Seattle, Wash., on September 16. The skins were forwarded from there by freight on September 17 via the Union Pacific system and Wabash

FIGURE 14.—Processing Alaska fur-seal skins at St. Louis, Mo.

Railway Co. and were delivered to the department's selling agents at St. Louis, Mo., on September 27.

SALES

In 1929 a total of 29,246 fur-seal skins, taken on the Pribilof Islands, were sold at two public auction sales held at St. Louis. There were also sold through special sales 100 fur-seal skins taken on those islands. Along with the following detailed statements of these sales, the sales of other fur-seal skins by the Department of Commerce for the account of the Government are included in order that the records may be complete.

Public auction sale, April 8, 1929.—At this sale 15,219 fur-seal skins taken at the Pribilof Islands, dressed, dyed, and machined, sold for $469,439.50; and 5 others skins taken at the Pribilof Islands, consisting of 1 dressed, 1 unhaired and dressed, and 3 raw salted skins, sold for $3; a grand total of $469,442.50. Of the dressed, dyed, and machined skins, 5,334 were dyed black, 9,884 logwood brown (Bois de Campêche) and 1 golden chestnut (Châtaigne d'Or).

Public auction sale, September 30, 1929.—At this sale 14,022 fur-seal skins taken at the Pribilof Islands, dressed, dyed, and machined, sold for $349,648. Of these skins, 5,022 were dyed black, and 9,000 logwood brown (Bois de Campêche). There were also sold 142 dressed, dyed, and machined Japanese fur-seal skins for $3,467.50; 10 raw salted Japanese skins for $10; and 2 dressed, dyed, and machined confiscated skins for $33, making a grand total of $353,167.50 for fur-seal skins at this sale. The confiscated skins and the 142 Japanese skins were dyed logwood brown.

The 152 Japanese fur-seal skins sold on September 30, 1929, were the United States Government's share of such skins taken by the Japanese Government in 1928, delivered pursuant to the provisions of the North Pacific Sealing Convention of July 7, 1911.

Special sales.—In the calendar year 1929, 100 fur-seal skins taken at the Pribilof Islands were sold at special sales for $4,764.86. These skins were dressed, dyed, and machined, 50 being of the black dye and 50 logwood brown.

The following tables give further details in regard to all sales of fur-seal skins by the Department of Commerce for the account of the Government in 1929:

Sale of fur-seal skins at St. Louis, Mo., April 8, 1929

9,884 DRESSED, DYED, AND MACHINED PRIBILOF ISLANDS SKINS, DYED LOGWOOD BROWN (BOIS DE CAMPÊCHE)

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
1	40	Extra large	$65.00	$2,600.00
2	40	Extra large; scarred, faulty, etc	39.50	1,580.00
3	80	Large	60.00	4,800.00
4	80	do	60.00	4,800.00
5	80	do	60.00	4,800.00
6	80	do	60.50	4,840.00
7	80	do	61.50	4,920.00
8	35	do	60.50	2,117.50
9	80	do	61.00	4,880.00
10	80	do	63.50	5,080.00
11	45	do	62.00	2,790.00
12	45	do	64.50	2,902.50
13	80	Large; scarred, faulty, etc	36.50	2,920.00
14	80	do	38.00	3,040.00
15	80	do	38.00	3,040.00
16	80	do	38.50	3,080.00
17	80	do	38.00	3,040.00
18	40	do	38.00	1,520.00
19	80	do	39.00	3,120.00
20	80	do	37.50	3,000.00
21	80	do	38.00	3,040.00
22	60	10 large, 50 medium	56.50	3,390.00
23	60	21 large, 39 medium; scarred, faulty, etc	35.00	2,100.00
24	90	Medium	51.00	4,590.00
25	90	do	53.50	4,815.00
26	90	do	51.00	4,590.00
27	90	do	55.50	4,995.00
28	90	do	51.50	4,635.00
29	90	do	53.50	4,815.00
30	90	do	54.00	4,860.00
31	90	do	53.50	4,815.00
32	90	do	53.00	4,770.00
33	90	do	55.00	4,950.00
34	45	do	53.00	2,385.00
35	45	do	53.50	2,407.50
36	40	do	53.50	2,140.00
37	90	do	50.00	4,500.00
38	90	do	51.00	4,590.00
39	90	do	53.00	4,770.00
40	90	do	51.00	4,590.00
41	90	do	50.50	4,545.00
42	90	do	53.00	4,770.00
43	90	do	50.50	4,545.00

Sale of fur-seal skins at St. Louis, Mo., April 8, 1929—Continued

9,884 DRESSED, DYED, AND MACHINED PRIBILOF ISLANDS SKINS, DYED LOGWOOD BROWN (BOIS DE CAMPÊCHE)—Continued

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
44	90	Medium	$51.50	$4,635.00
45	45	do	52.50	2,362.50
46	45	do	52.50	2,362.50
47	40	do	52.00	2,080.00
48	90	Medium; scarred, faulty, etc	31.00	2,790.00
49	90	do	31.00	2,790.00
50	90	do	32.00	2,880.00
51	90	do	31.00	2,790.00
52	90	do	31.00	2,790.00
53	90	do	30.00	2,700.00
54	90	do	30.50	2,745.00
55	90	do	29.00	2,610.00
56	90	do	29.00	2,610.00
57	90	do	28.00	2,520.00
58	90	do	28.00	2,520.00
59	90	do	29.00	2,610.00
60	90	do	28.00	2,520.00
61	45	do	28.50	1,282.50
62	45	do	28.50	1,282.50
63	45	do	27.50	1,237.50
64	45	do	26.50	1,192.50
65	90	do	26.50	2,385.00
66	90	do	27.00	2,430.00
67	90	do	27.00	2,430.00
68	90	do	26.50	2,385.00
69	90	do	26.50	2,385.00
70	90	do	28.00	2,520.00
71	90	do	27.50	2,475.00
72	90	do	28.50	2,565.00
73	90	do	27.50	2,475.00
74	60	do	28.00	1,680.00
75	60	do	28.00	1,680.00
76	90	Small medium	36.00	3,240.00
77	60	do	36.50	2,190.00
78	90	do	36.00	3,240.00
79	90	Small medium; scarred, faulty, etc	20.00	1,800.00
80	90	do	20.00	1,800.00
81	60	do	19.00	1,140.00
82	60	do	20.00	1,200.00
83	44	III; 1 extra large, 14 large, 19 medium, 10 small medium	6.50	286.00
84	53	3 extra extra large, 30 extra large, 20 large	53.00	2,809.00
85	64	1 extra extra large, 19 extra large, 44 large	43.50	2,784.00
86	49	2 extra extra large, 6 extra large, 41 large	45.00	2,205.00
87	50	14 extra extra large, 36 extra large; scarred, faulty, etc	31.50	1,575.00
88	43	7 extra extra large, 36 extra large; scarred, faulty, etc	25.00	1,075.00
89	56	Extra large; scarred, faulty, etc	23.00	1,288.00
90	45	do	24.00	1,080.00
91	80	Large	42.50	3,400.00
92	80	do	41.00	3,280.00
93	40	do	47.00	1,880.00
94	80	do	44.50	3,560.00
95	80	do	47.50	3,800.00
96	40	do	49.00	1,960.00
97	80	Large; scarred, faulty, etc	27.50	2,200.00
98	80	do	26.00	2,080.00
99	80	do	26.50	2,120.00
100	55	do	26.50	1,457.50
101	80	do	26.00	2,080.00
102	80	do	27.00	2,160.00
103	72	do	26.50	1,908.00
104	63	do	26.00	1,638.00
105	90	Medium	37.00	3,330.00
106	90	do	36.00	3,240.00
107	90	do	36.00	3,240.00
108	63	do	33.00	2,079.00
109	90	do	32.50	2,925.00
110	90	do	33.00	2,970.00
111	90	do	33.00	2,970.00
112	90	do	32.50	2,925.00
113	56	do	33.00	1,848.00
114	90	Medium; scarred, faulty, etc	19.00	1,710.00
115	90	do	19.50	1,755.00
116	90	do	19.50	1,755.00
117	90	do	19.50	1,755.00
118	74	do	20.00	1,480.00
119	90	do	19.50	1,755.00
120	90	do	20.50	1,845.00
121	90	do	20.00	1,800.00

Sale of fur-seal skins at St. Louis, Mo., April 8, 1929—Continued

9,884 DRESSED, DYED, AND MACHINED PRIBILOF ISLANDS SKINS, DYED LOG-WOOD BROWN (BOIS DE CAMPÊCHE)—Continued

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
122	90	Medium; scarred, faulty, etc	$20.00	$1,800.00
123	90	do	21.00	1,890.00
124	35	do	22.00	770.00
125	58	56 medium, 2 small medium	35.00	2,030.00
126	44	Small medium	26.00	1,144.00
127	39	do	27.50	1,072.50
128	84	74 medium, 10 small medium; scarred, faulty, etc	17.00	1,428.00
129	52	Small medium; scarred, faulty, etc	14.50	754.00
130	82	do	15.50	1,271.00
131	39	III; 4 extra extra large, 35 extra large	2.00	78.00
132	45	III; large	2.50	112.50
133	55	III; 31 large, 24 medium	3.00	165.00
134	58	III; 29 medium, 29 small medium	2.00	116.00
135	1	Medium; scarred, faulty, etc	10.00	10.00
	9,884			354,456.00

5,334 DRESSED, DYED, AND MACHINED PRIBILOF ISLANDS SKINS, DYED BLACK

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
141	30	5 extra extra large, 14 extra large, 11 large	$45.00	$1,350.00
142	60	1 wig, 19 extra extra large, 40 extra large; scarred, faulty, etc	22.50	1,350.00
143	80	Large	47.00	3,760.00
144	80	do	47.00	3,760.00
145	80	do	48.00	3,840.00
146	80	do	49.50	3,960.00
147	80	Large; scarred, faulty, etc	25.00	2,000.00
148	80	do	23.50	1,880.00
149	80	do	21.00	1,680.00
150	80	do	20.00	1,600.00
151	80	do	17.50	1,400.00
152	80	do	19.50	1,560.00
153	80	do	19.00	1,520.00
154	80	do	19.00	1,520.00
155	47	do	26.00	1,222.00
156	90	Medium	32.00	2,880.00
157	90	do	32.00	2,880.00
158	90	do	31.50	2,835.00
159	90	do	29.50	2,655.00
160	90	do	32.00	2,880.00
161	90	do	32.50	2,925.00
162	90	do	31.00	2,790.00
163	90	do	29.50	2,655.00
164	90	do	29.50	2,655.00
165	90	do	30.00	2,700.00
166	90	do	32.00	2,880.00
167	45	do	32.50	1,462.50
168	40	do	33.50	1,340.00
169	90	Medium; scarred, faulty, etc	17.00	1,530.00
170	90	do	16.50	1,485.00
171	90	do	17.00	1,530.00
172	90	do	16.50	1,485.00
173	90	do	16.00	1,440.00
174	90	do	17.00	1,530.00
175	90	do	16.50	1,485.00
176	90	do	16.50	1,485.00
177	90	do	15.50	1,395.00
178	90	do	16.00	1,440.00
179	90	do	17.00	1,530.00
180	90	do	18.00	1,620.00
181	90	do	18.00	1,620.00
182	90	do	18.50	1,665.00
183	90	do	17.50	1,575.00
184	90	do	17.50	1,575.00
185	90	do	17.00	1,530.00
186	90	do	17.00	1,530.00
187	90	do	17.00	1,530.00
188	90	do	17.00	1,530.00
189	90	do	16.50	1,485.00
190	45	do	18.00	810.00
191	45	do	17.00	765.00
192	45	do	17.50	787.50
193	45	do	19.50	877.50
194	36	do	17.00	612.00
195	35	do	17.50	612.50
196	90	Small medium	24.00	2,160.00
197	90	do	23.00	2,070.00

Sale of fur-seal skins at St. Louis, Mo., April 8, 1929—Continued

5,334 DRESSED, DYED, AND MACHINED PRIBILOF ISLANDS SKINS, DYED BLACK—Continued

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
198	90	Small medium; scarred, faulty, etc	$12.50	$1,125.00
199	90	do	11.50	1,035.00
200	90	do	12.50	1,125.00
201	90	do	12.00	1,080.00
202	90	do	12.00	1,080.00
203	90	do	13.00	1,170.00
204	50	do	12.50	625.00
205	49	do	11.00	539.00
206	31	III; 1 wig, 4 extra large, 26 large	3.50	108.50
207	60	III medium	2.50	150.00
208	59	do	3.00	177.00
209	52	III small medium	2.50	130.00
	5,334			114,973.50

1 DRESSED, DYED, AND MACHINED PRIBILOF ISLANDS SKIN, DYED GOLDEN CHESTNUT (CHÂTAIGNE D'OR)

138	1	Small medium	$10.00	$10.00

1 DRESSED PRIBILOF ISLANDS SKIN

211	1	Skin	$1.00	$1.00

1 UNHAIRED AND DRESSED PRIBILOF ISLANDS SKIN

212	1	Faulty	$0.50	$0.50

3 RAW SALTED PRIBILOF ISLANDS SKINS

213	3	Faulty	$0.50	$1.50

Sale of fur-seal skins at St. Louis, Mo., September 30, 1929

9,000 DRESSED, DYED, AND MACHINED PRIBILOF ISLANDS SKINS, DYED LOGWOOD BROWN (BOIS DE CAMPÊCHE)

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
1	60	Extra large	$45.00	$2,700.00
2	60	do	45.00	2,700.00
3	60	do	45.00	2,700.00
4	60	Extra large; scarred, faulty, etc	28.00	1,680.00
5	30	do	28.00	840.00
6	70	Large	42.00	2,940.00
7	70	do	38.00	2,660.00
8	70	do	36.50	2,555.00
9	70	do	36.50	2,555.00
10	70	do	34.00	2,380.00
11	70	do	32.00	2,240.00
12	70	do	34.00	2,380.00
13	70	do	35.00	2,450.00
14	70	do	35.00	2,450.00
15	70	do	34.00	2,380.00
16	70	do	35.00	2,450.00
17	70	do	35.00	2,450.00
18	70	do	35.00	2,450.00
19	45	do	34.00	1,530.00
20	45	do	35.00	1,575.00
21	45	do	35.50	1,597.50
22	45	do	33.50	1,507.50

Sale of fur-seal skins at St. Louis, Mo., September 30, 1929—Continued

9,000 DRESSED, DYED, AND MACHINED PRIBILOF ISLANDS SKINS, DYED LOGWOOD BROWN (BOIS DE CAMPÊCHE)—Continued

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
23	70	Large	$34.50	$2,415.00
24	70	do	36.00	2,520.00
25	70	do	34.00	2,380.00
26	70	do	35.00	2,450.00
27	70	do	36.00	2,520.00
28	70	do	36.50	2,555.00
29	70	do	36.50	2,555.00
30	35	do	36.00	1,260.00
31	35	do	34.50	1,207.50
32	35	do	35.00	1,225.00
33	35	do	36.00	1,260.00
34	35	do	36.00	1,260.00
35	70	Large; scarred, faulty, etc	23.00	1,610.00
36	70	do	24.00	1,680.00
37	70	do	24.00	1,680.00
38	70	do	24.00	1,680.00
39	70	do	24.50	1,715.00
40	70	do	25.00	1,750.00
41	70	do	24.00	1,680.00
42	70	do	25.00	1,750.00
43	35	do	25.50	892.50
44	35	do	25.50	892.50
45	35	do	25.00	875.00
46	35	do	25.00	875.00
47	70	do	25.00	1,750.00
48	70	do	25.50	1,785.00
49	70	do	28.00	1,960.00
50	35	do	26.50	927.50
51	35	do	26.00	910.00
52	60	do	26.00	1,560.00
53	80	Medium	29.50	2,360.00
54	80	do	30.00	2,400.00
55	80	do	30.00	2,400.00
56	80	do	29.00	2,320.00
57	80	do	29.50	2,360.00
58	80	do	29.50	2,360.00
59	80	do	29.00	2,320.00
60	80	do	31.00	2,480.00
61	80	do	28.50	2,280.00
62	80	do	28.50	2,280.00
63	80	do	27.50	2,200.00
64	80	do	29.50	2,360.00
65	80	do	30.00	2,400.00
66	80	do	30.00	2,400.00
67	80	do	29.00	2,320.00
68	80	do	28.50	2,280.00
69	80	do	28.00	2,240.00
70	80	do	28.00	2,240.00
71	80	do	28.00	2,240.00
72	80	do	27.00	2,160.00
73	80	do	28.50	2,280.00
74	40	do	28.00	1,120.00
75	40	do	28.50	1,140.00
76	40	do	28.50	1,140.00
77	40	do	29.00	1,160.00
78	40	do	28.00	1,120.00
79	40	do	28.50	1,140.00
80	40	do	28.50	1,140.00
81	80	do	28.00	2,240.00
82	80	do	28.00	2,240.00
83	80	do	28.50	2,280.00
84	80	do	26.00	2,080.00
85	80	do	26.50	2,120.00
86	80	do	27.00	2,160.00
87	80	do	27.00	2,160.00
88	80	do	27.00	2,160.00
89	80	do	27.00	2,160.00
90	80	do	27.00	2,160.00
91	80	do	26.50	2,120.00
92	80	do	26.50	2,120.00
93	60	do	27.00	1,620.00
94	40	do	26.00	1,040.00
95	40	do	26.00	1,040.00
96	40	do	26.50	1,060.00
97	40	do	27.00	1,080.00
98	65	18 large, 47 medium	29.00	1,885.00
99	58	7 large, 51 medium	27.00	1,566.00
100	35	13 large, 22 medium	30.50	1,067.50

Sale of fur-seal skins at St. Louis, Mo., September 30, 1929—Continued

9,000 DRESSED, DYED, AND MACHINED PRIBILOF ISLANDS SKINS, DYED LOGWOOD BROWN (BOIS DE CAMPÊCHE)—Continued

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
101	80	Medium; scarred, faulty, etc	$16.50	$1,320.00
102	80	do	18.00	1,440.00
103	80	do	17.00	1,360.00
104	80	do	18.00	1,440.00
105	80	do	17.50	1,400.00
106	80	do	17.50	1,400.00
107	80	do	18.00	1,440.00
108	80	do	18.00	1,440.00
109	80	do	18.00	1,440.00
110	80	do	18.00	1,440.00
111	80	do	18.00	1,440.00
112	60	do	18.00	1,080.00
113	40	do	18.50	740.00
114	40	do	18.50	740.00
115	40	do	19.00	760.00
116	40	do	18.50	740.00
117	80	do	18.00	1,440.00
118	80	do	19.00	1,520.00
119	80	do	18.50	1,480.00
120	80	do	18.50	1,480.00
121	80	do	18.75	1,500.00
122	80	do	19.00	1,520.00
123	53	do	18.50	980.50
124	53	do	18.00	954.00
125	60	do	18.75	1,125.00
126	72	1 extra large, 13 large, 58 medium; scarred, faulty, etc	15.50	1,116.00
127	39	20 large, 19 medium; scarred, faulty, etc	18.00	702.00
128	90	Small medium	22.50	2,025.00
129	59	do	22.50	1,327.50
130	57	do	23.00	1,311.00
131	56	do	23.00	1,288.00
132	56	do	23.50	1,316.00
133	56	do	24.00	1,344.00
134	36	do	24.50	882.00
135	24	do	24.50	588.00
136	31	18 medium, 13 small medium	26.00	806.00
137	75	Small medium; scarred, faulty, etc	16.00	1,200.00
138	50	do	16.00	800.00
139	50	do	15.50	775.00
140	51	4 large, 32 medium, 15 small medium; scarred, faulty, etc	17.50	892.50
141	45	Small medium; scarred, faulty, etc	15.50	697.50
142	44	III; 1 extra extra large, 8 large, 29 medium, 6 small medium	4.50	198.00
	9,000			240,636.50

5,022 DRESSED, DYED, AND MACHINED PRIBILOF ISLANDS SKINS, DYED BLACK

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
151	38	Extra large	$43.00	$1,634.00
152	35	Extra large; scarred, faulty, etc	19.00	665.00
153	35	do	18.50	647.50
154	70	Large	31.00	2,170.00
155	70	do	34.00	2,380.00
156	70	do	36.50	2,555.00
157	70	do	35.00	2,450.00
158	70	do	36.00	2,520.00
159	70	do	36.50	2,555.00
160	43	do	36.00	1,548.00
161	43	do	40.00	1,720.00
162	42	do	43.50	1,827.00
163	70	Large; scarred, faulty, etc	16.00	1,120.00
164	70	do	16.50	1,155.00
165	70	do	17.50	1,225.00
166	70	do	19.50	1,365.00
167	70	do	18.50	1,295.00
168	70	do	19.00	1,330.00
169	70	do	19.50	1,365.00
170	70	do	19.00	1,330.00
171	70	do	19.50	1,365.00
172	70	do	19.00	1,330.00
173	70	do	20.25	1,417.50
174	38	do	21.00	798.00
175	38	do	21.00	798.00
176	38	do	20.50	779.00
177	80	Medium	24.50	1,960.00
178	80	do	26.50	2,120.00
179	80	do	25.00	2,000.00

Sale of fur-seal skins at St. Louis, Mo., September 30, 1929—Continued

5,022 DRESSED, DYED, AND MACHINED PRIBILOF ISLANDS SKINS, DYED BLACK—Continued

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
180	80	Medium	$27.00	$2,160.00
181	80	do	27.50	2,200.00
182	80	do	26.00	2,080.00
183	80	do	25.50	2,040.00
184	80	do	26.50	2,120.00
185	80	do	29.00	2,320.00
186	80	do	28.00	2,240.00
187	80	do	27.00	2,160.00
188	80	do	29.00	2,320.00
189	80	do	28.00	2,240.00
190	40	do	29.50	1,180.00
191	40	do	28.50	1,140.00
192	40	do	33.00	1,320.00
193	40	do	30.50	1,220.00
194	80	Medium; scarred, faulty, etc	15.50	1,240.00
195	80	do	15.50	1,240.00
196	80	do	16.00	1,280.00
197	80	do	16.00	1,280.00
198	80	do	16.00	1,280.00
199	80	do	15.50	1,240.00
200	80	do	15.50	1,240.00
201	80	do	15.50	1,240.00
202	80	do	16.50	1,320.00
203	80	do	15.50	1,240.00
204	80	do	16.00	1,280.00
205	80	do	16.50	1,320.00
206	80	do	16.50	1,320.00
207	80	do	16.50	1,320.00
208	80	do	17.00	1,360.00
209	80	do	16.50	1,320.00
210	80	do	17.00	1,360.00
211	80	do	17.00	1,360.00
212	80	do	17.50	1,400.00
213	80	do	17.00	1,360.00
214	40	do	17.50	700.00
215	40	do	17.00	680.00
216	40	do	17.00	680.00
217	40	do	18.00	720.00
218	40	do	17.50	700.00
219	75	Small medium	22.00	1,650.00
220	75	do	21.00	1,575.00
221	90	Small medium; scarred, faulty, etc	12.50	1,125.00
222	90	do	13.00	1,170.00
223	60	do	14.00	840.00
224	59	do	14.00	826.00
225	33	III; 13 large, 17 medium, 3 small medium	5.50	181.50
	5,022			109,011.50

2 CONFISCATED SKINS

231	1	Medium; dressed, dyed, and machined logwood brown (Bois de Campêche)	$18.00	$18.00
232	1	Small medium; dressed, dyed, and machined logwood brown (Bois de Campêche)	15.00	15.00
	2			33.00

142 SKINS RECEIVED FROM JAPANESE GOVERNMENT UNDER TREATY PROVISIONS

241	58	7 extra extra large, 17 extra large, 22 large, 8 medium, 4 small medium, dressed, dyed, and machined logwood brown (Bois de Campêche)	$28.00	$1,624.00
242	27	1 extra extra large, 1 extra large, 18 large, 7 medium, dressed, dyed, and machined logwood brown (Bois de Campêche)	28.50	769.50
243	57	6 extra extra large, 14 extra large, 21 large, 14 medium, 2 small medium; scarred, faulty, etc., dressed, dyed, and machined logwood brown (Bois de Campêche)	19.00	1,083.00
	142			3,476.50

10 SKINS RECEIVED FROM JAPANESE GOVERNMENT UNDER TREATY PROVISIONS

244	10	Skins, salted	$1.00	$10.00

Special sales of Pribilof Islands fur-seal skins in 1929

Date	Number of skins	Description	Price per skin	Total
		DRESSED, DYED, AND MACHINED		
July 31	6	Dyed black, large	$47.78	$286.68
	20	Dyed black, medium	31.20	624.00
	46	Dyed logwood brown (Bois de Campêche), large	61.14	2,812.44
	4	Dyed logwood brown (Bois de Campêche), medium	52.51	210.04
Aug. 31	5	Dyed black, large	47.78	238.90
	19	Dyed black, medium	31.20	592.80
	100			4,764.86

Comparative values, by sizes and grades, with percentages each size, of Pribilof sealskins sold at public auction in 1929

Classes and sales	Grade	Number	High	Low	Average	Total	Total number	Average price	Total price	Percentage
DYED BLACK										
Wig: Apr. 8	Scarred, faulty, etc	1	$22.50	$22.50	$22.50	$22.50	2	$13.00	$26.00	0.04
	III	1	3.50	3.50	3.50	3.50				
Extra extra large: Apr. 8	I and II	5	45.00	45.00	45.00	225.00	24	27.19	652.50	.45
	Scarred, faulty, etc	19	22.50	22.50	22.50	427.50				
Extra large:										
Apr. 8	I and II	14	45.00	45.00	45.00	630.00	58	26.62	1,544.00	1.09
	Scarred, faulty, etc	40	22.50	22.50	22.50	900.00				
	III	4	3.50	3.50	3.50	14.00				
Sept. 30	I and II	38	43.00	43.00	43.00	1,634.00	108	27.28	2,946.50	2.15
	Scarred, faulty, etc	70	19.00	18.50	18.75	1,312.50				
Large:										
Apr. 8	I and II	331	49.50	45.00	47.78	15,815.00	1,044	29.01	30,288.00	19.57
	Scarred, faulty, etc	687	26.00	17.50	20.93	14,382.00				
	III	26	3.50	3.50	3.50	91.00				
Sept. 30	I and II	548	43.50	31.00	35.99	19,725.00	1,445	25.24	36,469.00	28.77
	Scarred, faulty, etc	884	21.00	16.00	18.86	16,672.50				
	III	13	5.50	5.50	5.50	71.50				
Medium:										
Apr. 8	I and II	1,075	33.50	29.50	31.20	33,537.50	3,387	20.80	70,454.00	63.50
	Scarred, faulty, etc	2,141	19.50	15.50	17.03	36,459.50				
	III	171	3.00	2.50	2.67	457.00				
Sept. 30	I and II	1,200	33.00	24.50	27.35	32,820.00	3,017	20.68	62,393.50	60.08
	Scarred, faulty, etc	1,800	18.00	15.50	16.38	29,480.00				
	III	17	5.50	5.50	5.50	93.50				
Small medium:										
Apr. 8	I and II	180	24.00	23.00	23.50	4,230.00	819	14.66	12,009.00	15.35
	Scarred, faulty, etc	639	13.00	11.00	12.17	7,779.00				
Sept. 30	I and II	150	22.00	21.00	21.50	3,225.00	452	15.93	7,202.50	9.00
	Scarred, faulty, etc	299	14.00	12.50	13.25	3,961.00				
	III	3	5.50	5.50	5.50	16.50				
All classes:										
Apr. 8							5,334	21.55	114,973.50	100.00
Sept. 30							5,022	21.71	109,011.50	100.00

DYED LOGWOOD BROWN (BOIS DE CAMPÊCHE)										
Extra extra large:										
Apr. 8	I and II	6	53.00	43.50	48.75	292.50				
	Scarred, faulty, etc	21	31.50	25.00	29.33	616.00	31	29.56	916.50	.31
	III	4	2.00	2.00	2.00	8.00				
Sept. 30	III	1	4.50	4.50	4.50	4.50	1	4.50	4.50	.01
Extra large:										
Apr. 8	I and II	95	65.00	43.50	55.65	5,286.50				
	Scarred, faulty, etc	213	39.50	23.00	28.08	5,982.00	344	32.98	11,345.00	3.48
	III	36	6.50	2.00	2.13	76.50				
Sept. 30	I and II	180	45.00	45.00	45.00	8,100.00	271	39.25	10,635.50	3.01
	Scarred, faulty, etc	91	28.00	15.50	27.86	2,535.50				
Large:										
Apr. 8	I and II	1,200	64.50	41.00	54.33	65,194.00				
	Scarred, faulty, etc	1,291	39.00	26.00	32.67	42,178.50	2,581	41.72	107,669.00	26.11
	III	90	6.50	2.50	3.29	296.50				
Sept. 30	I and II	1,793	42.00	27.00	35.28	63,265.00				
	Scarred, faulty, etc	1,077	28.00	15.50	24.70	26,604.00	2,878	31.24	89,905.00	31.98
	III	8	4.50	4.50	4.50	36.00				
Medium:										
Apr. 8	I and II	2,735	56.50	32.50	47.10	128,829.50				
	Scarred, faulty, etc	3,313	35.00	10.00	26.03	86,228.00	6,120	35.18	215,311.00	61.92
	III	72	6.50	2.00	3.52	253.50				
Sept. 30	I and II	3,278	31.00	26.00	28.18	92,359.00				
	Scarred, faulty, etc	1,855	19.00	15.50	18.02	33,420.50	5,162	24.39	125,910.00	57.36
	III	29	4.50	4.50	4.50	130.50				
Small medium:										
Apr. 8	I and II	325	36.50	26.00	33.71	10,956.50				
	Scarred, faulty, etc	444	20.00	14.50	18.32	8,135.00	808	23.78	19,214.50	8.18
	III	39	6.50	2.00	3.15	123.00				
Sept. 30	I and II	447	26.00	22.50	23.31	10,419.50				
	Scarred, faulty, etc	235	17.50	15.50	15.89	3,735.00	688	20.61	14,181.50	7.64
	III	6	4.50	4.50	4.50	27.00				
All classes:										
Apr. 8							9,884	35.86	354,456.00	100.00
Sept. 30							9,000	26.74	240,636.50	100.00
DYED GOLDEN CHESTNUT (CHÂTAIGNE D'OR)										
Small medium: Apr. 8	I and II	1	10.00	10.00	10.00	10.00	1	10.00	10.00	100.00
MISCELLANEOUS										
Apr. 8	Dressed	1	1.00	1.00	1.00	1.00				
	Unhaired and dressed	1	.50	.50	.50	.50	5	.60	3.00	100.00
	Raw salted	3	.50	.50	.50	1.50				

DISPOSITION OF FUR-SEAL SKINS TAKEN AT PRIBILOF ISLANDS

On January 1, 1929, 40,025 fur-seal skins taken at the Pribilof Islands were on hand. Of these, 801 were at the Pribilof Islands, 39,213 at St. Louis, Mo., and 11 at Washington. In 1929, 40,068 Pribilof skins were secured at the islands, 29,346 were disposed of, and 2 were unaccounted for due probably to a miscount in packing that will be corrected later, leaving 50,745 on hand at December 31, 1929. The following tables show further details in regard to fur-seal skins taken on the Pribilof Islands, as well as details in regard to other Government-owned fur-seal skins under the control of the Department of Commerce.

Summary of Government-owned fur-seal skins in the custody of Fouke Fur Co., St. Louis, Mo., calendar year 1929

Source	On hand Jan. 1	Receipts in 1929	Sales in 1929	On hand Dec. 31
Taken on Pribilof Islands:				
Calendar year 1925	1		1	
Calendar year 1926	1		1	
Calendar year 1927	8,913		8,913	
Calendar year 1928	30,298	801	20,431	10,668
Calendar year 1929		39,266		39,266
United States' share of Japanese fur-seal skins: Season of 1928		152	152	
Confiscated fur-seal skins		6	2	4
Total	39,213	40,225	29,500	49,938

Summary of all fur-seal skins handled on Pribilof Islands, calendar year 1929

Island	On hand Jan. 1	Number taken	Total handled	Number shipped	Unaccounted for [1]	On hand Dec. 31
St. Paul	501	33,216	33,717	33,215	2	500
St. George	300	6,852	7,152	6,852		300
Total	801	40,068	40,869	40,067	2	800

[1] When skins taken in the commercial sealing season in 1929 were packed for shipment the count was 2 less than the number taken. It is believed that a miscount was made in packing the skins and that the error will be rectified when the skins are unpacked at St. Louis.

Summary of all Government-owned fur-seal skins under control of Department of Commerce, calendar year 1929

Source	On hand Jan. 1	Receipts in 1929	Sales in 1929	Unaccounted for [1]	On hand Dec. 31
Taken on Pribilof Islands:					
Calendar year 1918, held for reference purposes	7				7
Calendar year 1923	3				3
Calendar year 1924	1				1
Calendar year 1925	1		1		
Calendar year 1926	1		1		
Calendar year 1927	8,913		8,913		
Calendar year 1928	31,099		20,431		10,668
Calendar year 1929		40,068		2	40,066
Miscellaneous skins held for reference purposes	4				4
United States' share of Japanese sealskins, season of 1928		152	152		
Confiscated skins		6	2		4
Total	40,029	40,226	29,500	2	[2] 50,753

[1] When skins taken in the commercial sealing season in 1929 were packed for shipment the count was 2 less than the number taken. It is believed that a miscount was made in packing the skins and that the error will be rectified when the skins are unpacked at St. Louis.

[2] 800 skins at Pribilof Islands; 49,938 in custody of Fouke Fur Co.; 15 in custody of Washington office, Bureau of Fisheries.

SHIPMENT AND SALE OF FOX SKINS

The 79 blue and 8 white fox skins taken on St. Paul Island in the season of 1928–29, and the 465 blue-fox skins and 1 white skin taken on St. George Island in the same season were placed aboard the U. S. S. *Sirius* for shipment and reached Seattle on September 16, whence they were forwarded by express on the next day to the bureau's selling agents at St. Louis, Mo.

The above skins were sold at public auction at St. Louis on September 30, 1929. The blue pelts sold for $35,865, an average of $65.93 per skin; and the white pelts brought $556, an average of $61.78 per skin. The maximum price per skin was $185, obtained for two blue pelts in separate lots. Further details are given in the following tables:

Sale of 544 blue and 9 white fox skins at St. Louis, Mo., September 30, 1929

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot	Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
		BLUE-FOX SKINS					BLUE-FOXSKINS—con.		
501	1	Extra extra fine	$185.00	$185.00	554	1	Fine silvery	$140.00	$140.00
502	1	Extra fine	185.00	185.00	555	4	Fine dark	110.00	440.00
503	1	do	125.00	125.00	556	3	I silvery	94.00	282.00
504	1	do	145.00	145.00	557	1	do	92.50	92.50
505	1	Fine	140.00	140.00	558	1	do	86.00	86.00
506	1	Fine silvery	140.00	140.00	559	2	do	87.00	174.00
507	1	do	160.00	160.00	560	3	I dark	89.00	267.00
508	1	do	150.00	150.00	561	3	do	76.00	228.00
509	1	do	145.00	145.00	562	3	do	70.00	210.00
510	2	I silvery	130.00	260.00	563	4	do	75.00	300.00
511	4	do	129.00	516.00	564	9	I	76.00	684.00
512	2	do	140.00	280.00	565	10	I	73.00	730.00
513	4	I pale silvery	105.00	420.00	566	8	I	68.00	544.00
514	1	do	110.00	110.00	567	4	II silvery	68.00	272.00
515	2	do	110.00	220.00	568	6	II dark	52.00	312.00
516	1	do	105.00	105.00	569	10	II	54.00	540.00
517	2	I silvery	102.00	204.00	570	8	II	50.00	400.00
518	2	I	106.00	212.00	571	10	II	58.00	580.00
519	2	I pale	94.00	188.00	572	11	II low	38.00	418.00
520	5	I dark	89.00	445.00	573	8	do	38.00	304.00
521	1	do	115.00	115.00	574	5	do	44.00	220.00
522	3	do	106.00	318.00	575	1	Extra fine	130.00	130.00
523	3	I	112.00	336.00	576	1	Fine silvery	135.00	135.00
524	3	I	104.00	312.00	577	2	Fine	92.00	184.00
525	3	I	106.00	318.00	578	1	do	65.00	65.00
526	6	II silvery	76.00	456.00	579	1	do	86.00	86.00
527	2	do	75.00	150.00	580	2	I silvery	90.00	180.00
528	2	II dark	78.00	156.00	581	1	do	110.00	110.00
529	4	II	66.00	264.00	582	2	do	92.00	184.00
530	4	II	68.00	272.00	583	5	I dark	79.00	395.00
531	5	II low	38.00	190.00	584	6	do	76.00	456.00
532	7	III	17.00	119.00	585	4	do	76.00	304.00
533	1	Extra extra fine	175.00	175.00	586	10	I	72.00	720.00
534	1	Extra fine	145.00	145.00	587	8	I	68.00	544.00
535	1	Fine silvery	150.00	150.00	588	9	I pale	62.00	558.00
536	2	Fine dark	135.00	270.00	589	4	II silvery	62.00	248.00
537	3	I silvery	110.00	330.00	590	12	II dark	58.00	696.00
538	3	do	94.00	282.00	591	7	II	45.00	315.00
539	5	I dark	87.00	435.00	592	8	II	50.00	400.00
540	5	do	76.00	380.00	593	9	II	42.00	378.00
541	6	I	76.00	456.00	594	5	II	40.00	200.00
542	8	I	68.00	544.00	595	3	II	48.00	144.00
543	3	I pale	78.00	234.00	596	14	II low	44.00	616.00
544	3	II silvery	78.00	234.00	597	11	do	46.00	506.00
545	5	II dark	58.00	290.00	598	1	Extra fine	115.00	115.00
546	10	II	56.00	560.00	599	2	Fine	102.00	204.00
547	12	II	58.00	696.00	600	2	do	102.00	204.00
548	8	II	46.00	368.00	601	1	Fine silvery	117.50	117.50
549	10	II pale	54.00	540.00	602	1	Fine	86.00	86.00
550	8	II low	46.00	368.00	603	1	do	76.00	76.00
551	7	do	34.00	238.00	604	3	I silvery	110.00	330.00
552	12	III	24.00	288.00	605	2	do	114.00	228.00
553	1	Extra extra fine	145.00	145.00	606	1	do	98.00	98.00

Sale of 544 blue and 9 white fox skins at St. Louis, Mo., September 30, 1929—Con.

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot	Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
		BLUE-FOX SKINS—continued					BLUE-FOX SKINS—continued		
607	3	I dark	88.00	264.00	619	2	II low	36.00	72.00
608	6	do	71.00	426.00	620	14	do	32.00	448.00
609	4	do	72.00	288.00		544			35,865.00
610	6	I	68.00	408.00					
611	10	I	68.00	680.00					
612	3	II silvery	68.00	204.00			WHITE-FOX SKINS		
613	9	II	50.00	450.00					
614	10	II	52.00	520.00	621	8	I and II	64.00	512.00
615	11	II	52.00	572.00	622	1	II stained	44.00	44.00
616	7	II	44.00	308.00		9			556.00
617	8	II	48.00	384.00					
618	4	II low	34.00	136.00		553			36,421.00

SEA-OTTER SKINS

Five sea-otter skins, reported taken from animals found dead, were seized by the bureau in 1929 and forwarded to the Fouke Fur Co., at St. Louis, Mo., to be sold for Government account. Three of these skins were taken on shores of the Aleutian Islands and surrendered through the United States commissioner at Unalaska, and two were taken in the vicinity of Yantarni Bay, near Cape Kunmik, on the south side of the Alaska Peninsula, and turned over to the bureau's warden at Kodiak. The skins were sold at public auction on September 30, 1929, for $963—one of them bringing $450.

FUR-SEAL PATROL

UNITED STATES COAST GUARD

Five cutters—the *Chelan*, *Unalga*, *Snohomish*, *Northland*, and *Haida*—were assigned by the United States Coast Guard to take part in the patrol for the protection of the fur seals and sea otters in waters of the North Pacific Ocean and Bering Sea.

The *Snohomish* began to patrol off the mouth of Columbia River on April 5 and covered the area as far north as Dixon Entrance until May 17. The *Unalga* patrolled from Dixon Entrance northward and westward to Unalaska and then took part in the general patrol in the Bering Sea region. The *Chelan* sailed from Seattle for Unalaska in April and the *Haida* in June, patrolling en route and thereafter maintaining the patrol in Bering Sea and around the Pribilof Islands. While on its annual trip to the Arctic Ocean the *Northland* patrolled waters frequented by the fur seals. The season's patrol extended as far westward as Attu, the westernmost island of the Aleutian Islands, and was prosecuted as long as the circumstances required.

BUREAU OF FISHERIES

An Executive order of January 14, 1929, superseding one dated April 11, 1924, named each of the bureau's boats in the Alaska service as duly authorized and directed to take part in the patrol for the protection of the fur seals and sea otters which frequent the waters of the North Pacific Ocean.

Throughout April and May the *Brant* was detailed to patrol waters in the vicinity of Cape Flattery. The *Auklet* was engaged in the seal patrol near Sitka during the month of April.

SEALING PRIVILEGES ACCORDED ABORIGINES

The North Pacific Sealing Convention of July 7, 1911, provides that Indians and other aborigines dwelling on the coasts of the waters designated by the convention may take fur-seal skins under limited conditions. There have been authenticated by agents of the United States 1,586 fur-seal skins taken by Indians in 1929 in the waters off the coasts of Washington and southeast Alaska. The details are as follows:

Washington.—A total of 591 skins taken by the Indians of Washington were authenticated. Of these 166 were from males, 421 from females, 3 from unborn pups, and 1 from a seal whose sex was not recorded. The skins were taken by Indians of La Push and Neah Bay and in the months from February to June, both inclusive. Dr. Carl B. Boyd, Superintendent of the Neah Bay Indian Agency, Neah Bay, Wash., attended to the authentication of the skins for the bureau.

Alaska.—Nine hundred and ninety-five skins taken by natives of Sitka were authenticated. Of these 582 were reported to be from males, 291 from females, and 122 from unborn pups. The seals from which the skins were secured were taken in waters off Biorka Island and Cape Edgecumbe and in the months of April, May, and June.

An official report received by the bureau stated that 3,383 fur-seal skins were taken by natives of British Columbia in 1929.

JAPANESE SEALSKINS DELIVERED TO THE UNITED STATES

The North Pacific Sealing Convention of July 7, 1911, provides that 10 per cent of the fur-seal skins taken annually upon Robben Island or any other islands or shores of waters defined by the convention subject to the jurisdiction of Japan shall be turned over to the United States Government unless the number of seals frequenting the Japanese islands falls below 6,500, enumerated by official count.

In January, 1929, there were delivered at St. Louis, Mo., 152 fur-seal skins, comprising the United States Government's share of such skins taken by the Japanese Government in 1928. They were sold at public auction on September 30, 1929. Before being sold 142 were dressed, dyed, and machined. The remaining 10 were sold in the raw salted condition. Details of the sale are given on page 326.

The United States Government's share of fur-seal skins taken by the Japanese Government in 1929 was 170. They were received at St. Louis in January, 1930.

VISIT TO PRIBILOF ISLANDS BY RUSSIANS

In June a permit was issued by the Department of Commerce authorizing two Russians, Leonty Vasilievich Boitsoff and Titus Ardeevich Malkovitch, to visit the Pribilof Islands for the purpose of observing fur seals and making general observations of the activities at those islands over a period of not exceeding three weeks. They arrived at the Pribilofs on July 14 and left July 25. The U. S. F. S. *Eider* afforded them transportation from Dutch Harbor to the Pribilofs and on their departure took them from the islands to Akutan.

COMPUTATION OF FUR SEALS, PRIBILOF ISLANDS, 1929

By Harry J. Christoffers

The fur-seal herd of the Pribilof Islands at the present time is in a very healthful condition. The large number of breeding bulls—harem, idle, and surplus bulls—shows that the present requirements of the herd have been amply provided for through the reserving of part of the 3-year-old males for breeding purposes. It is believed that at present there are not more bulls than are desirable.

Though the number of breeding bulls has been greatly increased, there is no apparent increase in the amount of fighting on the rookeries or in the percentage of dead pups. In spite of the increased number of bulls there are still a few young bulls holding harems. Many branded 9-year-olds were observed holding harems.

In the early part of the season the large number of bulls on the hauling grounds causes some trouble in making drives, especially when the weather is warm. As the season advances the number of bulls in drives decreases, though there are always more or less of them. Toward the end of the season the 2-year-olds cause more trouble than the bulls. There are now so many 2-year-olds that it is not advisable to drive large numbers of bachelors for any great distance during the last week in July. This is, therefore, the best possible time to discontinue killing and make provision for breeding requirements.

After the discontinuance of killing operations on July 23, it was possible this season to mark for breeding purposes over eight thousand 3-year-old males before August 1. There were still a great many unmarked 3-year-olds to be observed on the hauling grounds. It is felt, therefore, that sufficient 3-year-olds were reserved. With normal conditions the number of 3-year-olds which could be reserved after July 23 would increase each year in approximately the same proportion as the growth of the herd. Killing operations may, therefore, be discontinued at about this time each season to provide for a proper reserve.

BULLS

The census of harem and idle bulls this season was taken on St. Paul Island between July 16 and July 22, inclusive, and on St. George Island on July 23 and 24. The count on Zapadni and South rookeries, St. George Island, was made by Agent H. A. Peterson and Storekeeper A. J. Messner. The counts on all other rookeries, on both islands, were made by Special Agent A. Christoffersen and the writer. It is considered advisable for two persons to make each count simultaneously so that final figures may be verified.

Harem areas continued to expand this season, especially toward the rear of the rookeries. A number of harems were again found on hauling grounds. In a relatively few years, if the present rate of expansion continues, there will be no hauling grounds on Reef rookery, St. Paul Island. Later, when the Gorbatch hauling grounds are covered with harems, the bachelors will probably haul out on Zoltoi sands. These changes would result in shortening materially the length of the drives from these rookeries to the killing field.

It was impossible, on account of weather conditions, to count Sivutch rookery. A conservative estimate, therefore, has been included.

In 1928 there was an actual decrease in the number of bulls on Kitovi and Lukanin rookeries, due to late ice conditions. This year these rookeries recovered their normal position.

Zapadni rookery, St. George Island, showed a decrease in harems, while South rookery, on the same island, showed an unusual increase. A hauling ground also appeared on South rookery, which undoubtedly claimed a great many of the bachelors that would otherwise have hauled out at Zapadni. This is unfortunate, as it is impossible to hold a drive or killing at South rookery.

To facilitate the counting of harems, three additional tripods were erected in the spring—one each on Reef, Gorbatch, and Polovina rookeries. All other tripods and walks were repaired, and in some cases extensions were made on account of greatly expanded harem areas. Additional tripods and extensions to walks are contemplated before another season.

A great many iron-branded 9-year-old bulls were observed holding harems. A number of these bulls also were to be found on hauling grounds throughout the season. No matter what their age, most of the late-arriving bulls are probably forced to spend the major portion of the season on hauling grounds or in the rear of rookeries.

Rookeries now cover such extensive areas that idle and surplus bulls do not remain continuously in the rear of rookeries or on hauling grounds. Large numbers of these bulls constantly roam between the hauling grounds and the rookeries.

Number of harem and idle bulls, approximate ratio of idle bulls to harem bulls, and average harem, 1929

Rookery	Date	Harem bulls	Idle bulls	Total	Approximate ratio of idle bulls to harem bulls	Average harem
St. Paul Island:						
Kitovi	July 16	260	51	311	1:5	39.11
Lukanin	do	104	11	115	1:9	47.28
Gorbatch	July 18	507	131	638	1:4	50.93
Ardiguen	do	48	14	62	1:3	50.89
Reef	do	1,123	293	1,416	1:4	46.19
Sivutch (estimated)		375	80	455	1:5	42.32
Lagoon	July 20	2		2		56.00
Tolstoi	July 16	543	106	649	1:5	56.23
Zapadni	July 17	486	102	588	1:5	60.38
Little Zapadni	do	299	53	352	1:6	50.03
Zapadni Reef	do	27	7	34	1:4	19.22
Polovina	July 19	344	79	423	1:4	30.65
Polovina Cliffs	do	189	44	233	1:4	30.55
Little Polovina	do	54	16	70	1:3	38.94
Morjovi	July 22	166	33	199	1:5	22.77
Vostochni	do	1,471	319	1,790	1:5	28.60
Total		5,998	1,339	7,337	1:4	41.82
St. George Island:						
North	July 24	431	76	507	1:6	47.48
Staraya Artil	do	323	93	416	1:3	47.74
Zapadni	July 23	92	31	123	1:3	23.65
South	do	48	16	64	1:3	10.62
East Reef	do	98	26	124	1:4	47.86
East Cliffs	do	197	52	249	1:4	67.96
Total		1,189	294	1,483	1:4	47.64
Total (both islands)		7,187	1,633	8,820	1:4	42.78

AVERAGE HAREM

The estimated average harem has been determined on the basis of an increase of 8 per cent for the cows. With normal conditions prevailing, the use of this rate of increase for the present will answer all practical requirements.

The average harem shows a very satisfactory decrease. This is due, no doubt, to the creation of a greatly increased reserve of breeding bulls.

Computation of breeding cows, based on annual increases of 8 per cent, and of average harems, in 1929

Rookery	Breeding cows		Harem bulls, 1929	Average harem		
	1928	1929		1929	1928	Increase (+) or decrease (−) in 1929 from 1928
St. Paul Island:						
Kitovi	9,417	10,170	260	39.11	47.56	−8.45
Lukanin	4,553	4,917	104	47.28	56.21	−8.93
Gorbatch	23,910	25,823	507	50.93	51.20	−.27
Ardiguen	2,262	2,443	48	50.89	39.68	+11.21
Reef	48,028	51,870	1,123	46.19	46.72	−.53
Sivutch	14,696	15,872	375	42.32	41.99	+.33
Lagoon (actual count pups)	115	112	2	56.00	57.50	−1.50
Tolstoi	28,273	30,535	543	56.23	61.60	−5.37
Zapadni	27,171	29,345	486	60.38	72.84	−12.46
Little Zapadni	13,850	14,958	299	50.03	66.59	−16.56
Zapadni Reef	481	519	27	19.22	20.91	−1.69
Polovina	9,764	10,545	344	30.65	35.12	−4.47
Polovina Cliffs	5,346	5,774	189	30.55	36.37	−5.82
Little Polovina	1,947	2,103	54	38.94	40.56	−1.62
Morjovi	3,500	3,780	166	22.77	22.01	+.76
Vostochni	38,961	42,078	1,471	28.60	32.99	−4.39
Total	232,274	250,844	5,998	41.82	45.91	−4.09
St. George Island:						
North	18,948	20,464	431	47.48	52.93	−5.45
Staraya Artil	14,277	15,419	323	47.74	60.50	−12.76
Zapadni	2,015	2,176	92	23.65	20.35	+3.30
South	472	510	48	10.62	15.73	−5.11
East Reef	4,343	4,690	98	47.86	48.80	−.94
East Cliffs	12,396	13,388	197	67.96	69.25	−1.29
Total	52,451	56,647	1,189	47.64	52.93	−5.29
Total (both islands)	284,725	307,491	7,187	42.78	47.06	−4.28

PUPS AND COWS

This season the average rate of increase of 8 per cent, as determined from complete pup counts of 1917 and 1922, has again been used for computing the number of cows and pups in the herd. The number of dead pups observed appeared to be about normal. The percentage of dead pups as counted in 1922, therefore, has been applied to each rookery. For comparative purposes only the estimated number of dead pups is included in the total number of pups.

It is possible that there has been a larger percentage of pups born as a result of making a larger reserve of 3-year-old males for breeding purposes. The sharp increase in the number of 2 and 3 year olds arriving at the islands would indicate either an increase in birth rate of more than 8 per cent or a sharp decrease in the mortality rate.

For the present it does not appear to be desirable to increase the percentage used to determine the number born. The final results will be the same if mortality rates are reduced. It has now been definitely determined that the mortality rates applied in 1925 and for several years thereafter (which rates were determined as a result of information secured from branding operations of 1923 and 1924) were too high.

Observations on a number of rookeries on July 12 and 13 showed at least 25 per cent less harems than when count was actually made. This showed that cows were arriving late. Within the next few days they hauled out in large numbers.

Distribution of pups on the Pribilof Islands, August 10, 1929, and comparison with distribution in 1928

Rookery	1929				1928	1929
	Living pups	Dead pups	Total pups	Per cent dead pups	Total pups	Increase
St. Paul Island:						
Kitovi	10,021	149	10,170	1.47	9,417	753
Lukanin	4,810	107	4,917	2.17	4,553	364
Gorbatch	25,601	222	25,823	.86	23,910	1,913
Ardiguen	2,385	58	2,443	2.39	2,262	181
Reef	51,113	757	51,870	1.46	48,028	3,842
Sivutch	15,485	387	15,872	2.44	14,696	1,176
Lagoon (actual count)	112		112		115	−3
Tolstoi	30,111	424	30,535	1.39	28,273	2,262
Zapadni	28,840	505	29,345	1.72	27,171	2,174
Little Zapadni	14,584	374	14,958	2.50	13,850	1,108
Zapadni Reef	515	4	519	.80	481	38
Polovina	10,384	161	10,545	1.53	9,764	781
Polovina Cliffs	5,667	107	5,774	1.85	5,346	428
Little Polovina	2,050	53	2,103	2.51	1,947	156
Morjovi	3,704	76	3,780	2.02	3,500	280
Vostochni	41,203	875	42,078	2.08	38,961	3,117
Total	246,585	4,259	250,844	1.70	232,274	18,570
St. George Island:						
North	20,178	286	20,464	1.40	18,948	1,516
Staraya Artil	15,021	398	15,419	2.58	14,277	1,142
Zapadni	2,152	24	2,176	1.12	2,015	161
South	501	9	510	1.72	472	38
East Reef	4,619	71	4,690	1.51	4,343	347
East Cliffs	13,189	199	13,388	1.49	12,396	992
Total	55,660	987	56,647	1.74	52,451	4,196
Total (both islands)	302,245	5,246	307,491	1.71	284,725	22,766

MORTALITY OF SEALS AT SEA

In 1925, due to information secured from branding operations, it was necessary to increase the mortality rates of seals for the first three years of their existence. It was advisable to continue using these mortality rates until it could be definitely proved that they were incorrect. It is now felt that it has been distinctly shown that the mortality rates established in 1925 were abnormal. For the present, therefore, it is desirable to use the mortality rates established for males prior to 1925 and to make adjustments accordingly in the number of seals credited to each age class for the first 3 years. This has been done in the computation for this season. The mortality rate for yearling females has been reduced to 40 per cent.

COMPLETE COMPUTATION

Following is a summary of the method used for computing the number of animals in the Pribilof Islands fur-seal herd in 1929, together with a recapitulation of the herd by classes. It will be noted that the increase in the total number of seals over 1928 was 100,014, or 11.48 per cent. The increase in 1928 over 1927 was 62,643, or 7.74 per cent.

Complete computation of fur seals, Pribilof Islands, as of August 10, 1929

Class	St. Paul Island	St. George Island	Total
Pups, estimated	250,844	56,647	307,491
Breeding cows, 3 years old and over, by inference	250,844	56,647	307,491
Harem bulls, counted	5,998	1,189	7,187
Idle bulls, counted	1,339	294	1,633
Yearlings, male and female, estimated:			
Females born in 1928	116,137	26,225	142,362
Natural mortality, 40 per cent	46,455	10,490	56,945
Yearling females, Aug. 10, 1929	69,682	15,735	85,417
Males born in 1928	116,137	26,226	142,363
Natural mortality, 40 per cent	46,455	10,490	56,945
Yearling males beginning 1929	69,682	15,736	85,418
Yearling males killed 1929	37		37
Yearling males, Aug. 10, 1929	69,645	15,736	85,381
2-year-olds, male and female, estimated:			
Yearling females, Aug. 10, 1928	59,126	13,355	72,481
Adjustment to decrease mortality rate of yearlings from 45 per cent to 40 per cent	5,375	1,214	6,589
Corrected total for Aug. 10, 1928	64,501	14,569	79,070
Natural mortality, 15 per cent	9,675	2,185	11,860
2-year-old females, Aug. 10, 1929	54,826	12,384	67,210
Yearling males, Aug. 10, 1928	53,721	12,140	65,861
Adjustment to decrease mortality rate of yearlings from 50 per cent to 40 per cent	10,750	2,429	13,179
Corrected total for Aug. 10, 1928	64,471	14,569	79,040
Yearling males killed fall 1928	5		5
Yearling males end of 1928	64,466	14,569	79,035
Natural mortality, 17.5 per cent	11,281	2,550	13,831
2-year-olds beginning 1929	53,185	12,019	65,204
2-year-olds killed 1929	781	69	850
2-year-old males, Aug. 10, 1929	52,404	11,950	64,354
3-year-old males, estimated:			
2-year-old males, Aug. 10, 1928	40,000	9,087	49,087
Adjustment to decrease mortality rate of yearlings from 50 per cent to 40 per cent	8,215	1,855	10,070
Corrected total for Aug. 10, 1928	48,215	10,942	59,157
2-year-old males killed fall of 1928	46	5	51
2-year-old males end of 1928	48,169	10,937	59,106
Natural mortality, 12.5 per cent	6,021	1,367	7,388
3-year-old males beginning 1929	42,148	9,570	51,718
3-year-old males killed 1929	31,635	6,444	38,079
3-year-old males, Aug. 10, 1929	10,513	3,126	13,639
4-year-old males, estimated:			
3-year-old males Aug. 10, 1928	(1)	(1)	11,133
3-year-old males killed, fall 1928	442	295	737
3-year-old males end of 1928			10,396
Natural mortality, 10 per cent			1,040
4-year-old males beginning 1929			9,356
4-year-old males killed 1929	219	35	254
4-year-old males, Aug. 10, 1929			9,102

[1] As it was not possible to allocate to each island the 3, 4, or 5 year old males in 1928, it is not possible to do this in respect to the 4, 5, or 6 year old males in 1929.

Complete computation of fur seals, Pribilof Islands, as of August 10, 1929—Contd.

Class	St. Paul Island	St. George Island	Total
5-year-old males, estimated:			
4-year-old males, Aug. 10, 1928	(1)	(1)	7,798
4-year-old males killed fall 1928			
4-year-old males end of 1928			7,798
Natural mortality, 10 per cent			780
5-year-old males beginning 1929			7,018
5-year-old males killed 1929	2		2
5-year-old males, Aug. 10, 1929			7,016
6-year-old males, estimated:			
5-year-old males, Aug. 10, 1928	(1)	(1)	13,001
5-year-old males killed fall 1928			
5-year-old males end of 1928			13,001
Natural mortality, 20 per cent			2,600
6-year-old males beginning 1929			10,401
6-year-old males killed 1929	2		2
6-year-old males, Aug. 10, 1929			10,399
Surplus bulls, 7 years and over, estimated:			
6-year-old males, Aug. 10, 1928	12,278	579	12,857
6-year-old males killed fall 1928			
6-year-old males end of 1928	12,278	579	12,857
Natural mortality, 20 per cent	2,455	116	2,571
7-year-old males beginning 1929	9,823	463	10,286
7-year-old males killed 1929			
7-year-old males, Aug. 10, 1929	9,823	463	10,286
Surplus bulls, Aug. 10, 1928	4,937	348	5,285
Natural mortality, 30 per cent	1,481	104	1,585
Remaining surplus for 1929	3,456	244	3,700
Breeding bulls of 1928	6,267	1,232	7,499
Natural mortality, 30 per cent	1,880	370	2,250
1928 bulls remaining 1929	4,387	862	5,249
Breeding bulls 1929	7,337	1,483	8,820
1928 bulls remaining, deducted	4,387	862	5,249
Increment of new bulls in 1929	2,950	621	3,571
7-year-old males computed for 1929	9,823	463	10,286
Surplus bulls computed for 1929	3,456	244	3,700
Total theoretical surplus bull stock, 1929	13,279	707	13,986
New increment of breeding bulls deducted	2,950	621	3,571
Surplus bulls in 1929	10,329	86	10,415
50 per cent deducted for losses due to fighting, natural causes, and errors in loss percentage in previous years	5,165	[2] 43	5,208
Surplus bulls, Aug. 10, 1929	5,164	43	5,207

RECAPITULATION

Class	Total	Class	Total
Pups	307,491	5-year-old males	7,016
Cows	307,491	6-year-old males	10,399
Harem bulls	7,187	Surplus bulls	5,207
Idle bulls	1,633		
Yearling females	85,417	Total, 1929	971,527
Yearling males	85,381		
2-year-old females	67,210	Total, 1928 [3]	871,513
2-year-old males	64,354	Numerical increase, 1929	100,014
3-year-old males	13,639	Per cent increase, 1929	11.48
4-year-old males	9,102		

[1] As it was not possible to allocate to each island the 3, 4, or 5 year old males in 1928, it is not possible to do this in respect to the 4, 5, or 6 year old males in 1929.
[2] Considerably more than 43 surplus bulls were observed on St. George Island. The total for the 2 islands may, however, be considered as approximately correct.
[3] The total for 1928 has not been altered to take care of adjustments made in 1929 to cover changes in mortality rates of certain ages.

REVIEW OF THE FISHERIES OF CALIFORNIA[1]

By R. H. Fiedler, *Chief, Division of Fishery Industries*

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INTRODUCTION

California is the only State in the southwestern section of the United States where commercial fishing is followed. The fisheries of this State rank second (from point of value to the fishermen) among those of the United States. In 1927 the 7,033 fishermen employed in the shore and vessel fisheries of California caught over 490,000,000 pounds of fishery products valued (to the fishermen) at more than $10,000,000. This is about 10 per cent of the total first value of the fisheries of the United States. In 1927 there were operated in the vessel fisheries 420 vessels of 5 net tons and over, with a combined carrying capacity of nearly 8,000 tons.

That portion of the catch marketed fresh, frozen, or cured, in 1927, was valued to wholesalers at approximately $6,500,000; that marketed canned, was valued at $17,828,000; and that marketed as by-products, such as fish meal and oil, was valued at $2,495,000. The total value at wholesale and packing plants was $26,823,000.

TREND OF CATCH

From 1889 to 1927 (see fig. 1) the general trend in size of catch has been upward. In 1889 it amounted to 53,500,000 pounds and during the following years hovered around this figure until 1899, when the total increased to 75,600,000 pounds. A decline during the next few years was followed by an upward swing, and in 1915 the total reached 93,300,000 pounds. Beginning with 1918, when the catch amounted to nearly 263,000,000 pounds, annual figures are available. Since 1923 the catch has shown a great increase, in 1927 amounting to over 490,000,000 pounds.

Judging from these figures one might be led to believe that the fisheries of California have had a phenomenal growth during the

[1] Appendix XI to the Report of the U. S. Commissioner of Fisheries for 1930. B. F. Doc. 1087. This document is Chapter V of "Commercial Survey of the Pacific Southwest" by C. R. Niklason of the U. S. Bureau of Foreign and Domestic Commerce. The chapter was prepared by R. H. Fiedler of the U. S. Bureau of Fisheries, partly from material gathered in the field by C. R. Niklason.

past few years. However, a study reveals that this increase has been occasioned almost entirely by larger catches of a few species of fish used for canning, which are termed "cannery" fish. These are pilchards (sardines) and tunas, the production of which amounted to about 176,000,000 pounds in 1918, 81,000,000 in 1921, and 413,000,000 in 1927. On the other hand, the catch of "market" fish, which includes all species of finfishes, although showing fluctuation, has remained in the neighborhood of 50,000,000 to 60,000,000 pounds in recent years. During this time about 80 per cent of the catch has consisted of cannery fish.

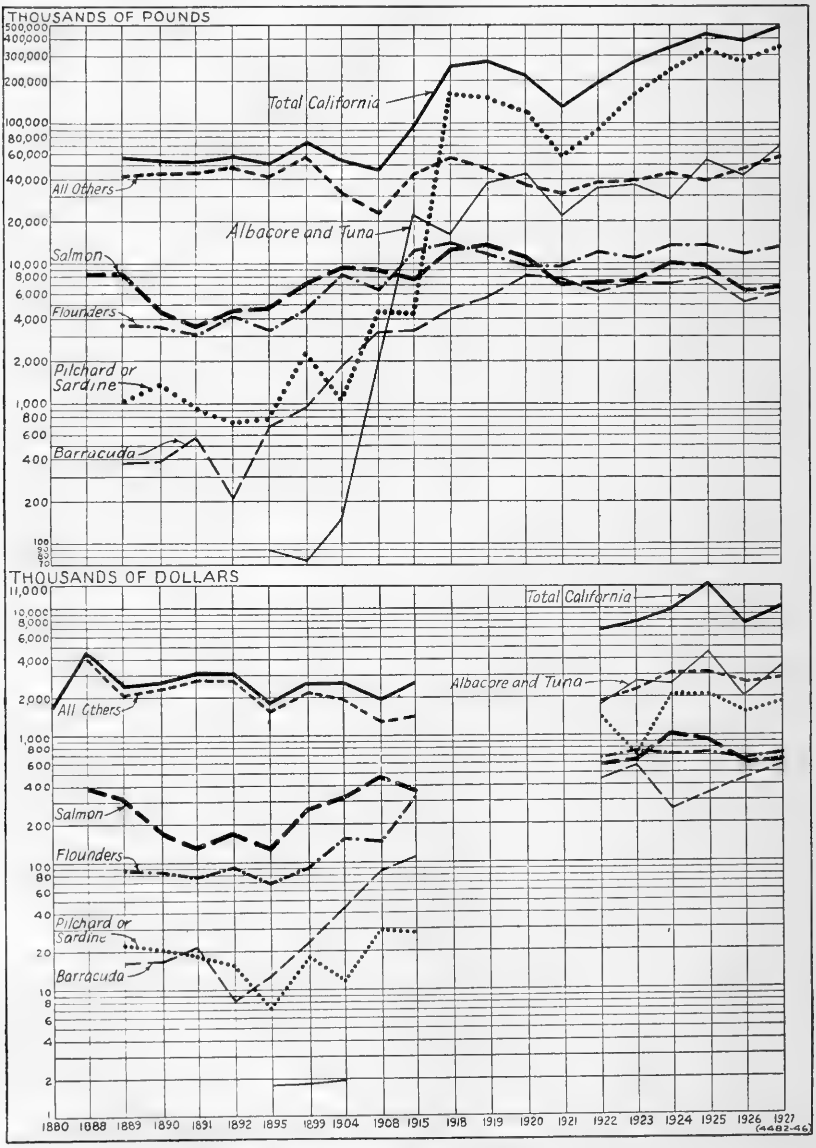

Figure 1.—Trend in production and value of California fisheries, 1880–1927

Fisheries of California (operating units), 1880–1927

Item	1880	1888	1889	1890	1891	1892	1895	1899	1904
Fishermen:									
On vessels	--------	1,396	1,123	1,385	1,532	1,798	1,419	885	838
On boats	[1] 2,089	3,188	2,940	2,922	2,964	2,968	2,716	2,538	3,491
Men on transporting vessels	--------	147	24	27	37	27	32	57	77
Shoresmen in canneries, etc	1,005	607	597	547	576	610	603	494	1,124
Vessels fishing	49	69	47	56	65	76	58	33	37
Net tonnage	5,246	9,544	8,398	9,908	10,045	11,952	9,215	5,952	6,096
Vessels transporting	--------	25	6	7	9	7	8	15	24
Net tonnage	--------	2,564	338	353	536	483	581	834	998
Motor boats	--------	--------	--------	--------	--------	--------	--------	--------	231
Sail and row boats, etc	853	1,354	1,351	1,364	1,397	1,391	1,442	[2] 1,355	1,798
Value of apparatus	$205,840	$354,675	$198,026	$197,421	$208,936	$216,456	$221,313	$249,631	$360,300

Item	1908 [3]	1915	1922	1923	1924	1925	1926	1927
Fishermen:								
On vessels	645	551	1,331	1,972	1,933	2,044	2,279	2,594
On boats	3,320	4,282	3,136	2,625	2,876	2,474	3,665	4,439
Men on transporting vessels	135	35	189	(4)	(4)	(4)	(4)	(4)
Shoresmen in canneries, etc	[5] 29	3,584	4,517	(4)	(4)	(4)	(4)	(4)
Vessels fishing	31	73	209	285	337	362	362	411
Net tonnage	4,480	3,198	3,887	4,071	5,821	5,350	6,675	7,995
Vessels transporting	21	20	53	(4)	(4)	(4)	(4)	(4)
Net tonnage	4,852	330	2,906	(4)	(4)	(4)	(4)	(4)
Motor boats	413	1,429	1,297	1,307	1,513	1,255	1,719	1,961
Sail and row boats, etc	1,716	1,169	292	135	132	150	255	350
Value of apparatus	$502,000	$606,944	$683,587	(4)	(4)	(4)	(4)	(4)

[1] Includes men on vessels and boats.
[2] Includes some motor boats.
[3] Data from report of the Bureau of the Census.
[4] Data not available.
[5] Does not include persons in canneries, wholesale houses, etc.

Source: U. S. Bureau of Fisheries.

Yield of California fisheries, by species, 1922–1927

Product	1922		1923		1924	
	Pounds		*Pounds*		*Pounds*	
Albacore and tuna	36,085,416	$1,807,097	38,777,737	$2,727,046	28,327,379	$2,592,294
Anchovies	652,516	13,049	307,074	19,292	346,951	1,984
Barracuda	6,284,065	439,817	7,200,575	575,285	7,128,523	257,022
Bonito	815,389	40,470	1,115,247	47,310	1,038,369	29,130
Cod, salted	1,680,000	84,000	1,398,000	69,900	2,884,028	190,041
Flounders	11,692,376	682,613	11,368,694	746,471	13,493,082	715,858
"California halibut"	--------	--------	--------	--------	2,576,261	348,759
Sole	6,949,557	211,800	7,086,035	286,631	8,835,351	307,809
Other	[1] 4,742,819	470,813	[1] 4,282,659	459,840	2,081,470	59,290
Grayfish	314,176	6,709	360,363	1,802	392,634	11,982
Hake	78,763	1,576	78,969	789	60,780	1,519
Halibut	--------	--------	--------	--------	132,637	15,916
Hardhead	18,206	1,183	9,563	96	19,023	761
Herring	341,614	6,832	383,950	3,994	435,620	8,602
Kingfish	579,754	11,595	411,564	10,301	384,317	8,892
"Ling cod"	569,821	33,936	467,357	23,369	400,432	24,026
Mackerel	2,498,197	75,455	3,592,446	144,082	3,240,534	86,834
Pilchard or sardine	92,114,542	1,381,008	159,197,006	704,280	242,685,958	2,079,727
Pompano	16,494	5,049	32,918	13,298	17,579	7,855
Rockfish	4,219,650	205,239	4,950,244	250,314	4,716,790	211,344
Sablefish	268,905	8,067	538,292	32,297	933,310	34,540
Salmon	7,236,580	590,509	7,090,260	638,122	10,015,269	1,025,838
Sea bass, black, or jewfish	87,559	4,502	226,995	22,168	231,404	4,163
Sea bass, white, or squeteague	2,904,054	176,993	2,520,263	224,869	1,515,584	185,086
Shad	1,133,270	55,513	1,285,383	58,088	1,539,217	74,553
Smelts	728,406	51,908	806,380	24,149	721,912	40,651
Steelhead trout	2,490	174	3,011	422	87,088	7,402
Striped bass	678,820	62,747	909,573	90,957	661,777	87,493
Whitefish	32,184	1,609	39,908	2,089	273,077	14,391

[1] Includes "California halibut."

Yield of California fisheries, by species, 1922–1927—Continued.

Product	1922		1923		1924	
	Pounds		*Pounds*		*Pounds*	
Swordfish	24,363	$506	11,691	$1,468	31,833	$3,610
Yellowtail	3,416,572	68,671	3,979,611	217,050	4,714,149	375,156
Miscellaneous fish [2]	1,305,686	67,329	1,626,101	116,872	2,051,194	144,275
Abalone (meat and shells)	1,523,543	60,943	1,587,733	60,367	449,362	249,646
Octopus	99,274	3,409	110,222	11,022	166,291	6,570
Squid	208,875	9,200	1,180,446	7,680	6,831,029	409,350
Shrimp	990,349	94,534	1,113,358	66,801	1,551,086	155,109
Clams	[3] 568,202	34,044	[3] 583,005	34,028	[4] 122,093	54,898
Oysters:						
Eastern, market	[3] 94,598	101,351	[3] 9,600	3,360	[4] 52,678	22,576
Native, market						
Crabs	844,472	66,543	1,075,800	148,459	1,506,816	126,616
Spiny lobsters	966,632	86,302	1,092,858	225,656	1,027,312	199,650
Whale oil	6,862,500	366,000	4,644,293	316,450	2,932,088	216,350
Sperm oil	37,875	2,525	15,585	1,282		
Other whale products	3,136,000	64,330	2,370,000	81,796	1,767,500	42,283
Miscellaneous products	14,664	644	61,296	3,079	8,567	1,147
Total	191,126,852	6,773,981	262,533,371	7,726,160	344,895,272	9,725,140

Product	1925		1926		1927	
	Pounds		*Pounds*		*Pounds*	
Albacore and tuna	53,910,440	$4,532,200	42,816,581	$2,058,713	69,218,809	$3,393,720
Anchovies	123,919	1,232	60,127	631	368,201	3,909
Barracuda	8,005,601	340,341	5,022,494	449,610	6,199,739	595,997
Bonito	866,530	25,983	3,078,666	93,256	1,716,957	49,997
Cod, salted	3,415,608	237,724	3,712,070	235,055	2,746,880	186,644
Flounders	13,765,487	736,996	11,893,881	651,481	13,068,555	730,812
"California halibut"	2,451,759	334,136	1,431,000	209,710	1,302,283	187,268
Sole	8,762,535	331,391	8,649,870	357,405	10,298,290	467,227
Other	2,551,193	71,469	1,813,011	84,366	1,467,982	76,317
Grayfish	372,332	3,723	506,723	3,115	324,903	5,822
Hake	22,017	441	58,335	1,458	84,553	2,144
Halibut	162,102	21,579	256,720	28,413	569,937	65,628
Hardhead	24,028	961	43,625	4,409	32,898	2,838
Herring	865,774	17,315	453,607	9,130	1,168,321	23,253
Kingfish	536,654	12,868	484,921	13,573	529,267	16,365
"Ling cod"	683,130	40,975	645,000	22,231	555,078	23,284
Mackerel	3,522,419	97,754	3,623,290	96,103	4,740,639	121,389
Pilchard or sardine	315,294,986	2,087,756	286,741,250	1,527,186	342,275,289	1,826,785
Pompano	10,536	4,808	8,125	3,908	55,127	6,408
Rockfish	5,453,510	266,069	7,538,448	348,069	6,377,179	292,631
Sablefish	722,472	26,118	183,065	9,802	992,354	43,616
Salmon	9,525,753	919,720	6,084,079	610,218	6,511,929	644,175
Sea bass, black, or jewfish	189,072	3,602	377,934	12,503	467,595	20,787
Sea bass, white, or squeteague	1,920,295	252,144	2,216,402	238,590	2,273,407	217,744
Shad	2,439,726	105,118	902,202	23,800	4,103,423	148,201
Smelts	751,669	40,953	883,123	79,158	965,921	55,794
Steelhead trout	222	31				
Striped bass	837,773	116,028	750,801	110,118	647,594	92,036
Whitefish	222,112	12,034	368,064	28,217	313,102	27,521
Swordfish	27,045	3,851	45,543	3,763	130,288	12,287
Yellowtail	3,179,891	272,717	5,023,114	266,045	4,224,853	195,463
Miscellaneous fish [2]	1,893,858	144,021	2,279,394	157,359	2,628,231	174,182
Abalone (meat and shells)	470,732	261,507	412,154	84,827	563,306	112,822
Octopus	133,449	12,027	63,304	6,260	36,693	3,837
Squid	1,891,220	119,167	3,135,561	45,806	6,014,113	55,734
Shrimp	1,460,234	146,023	1,431,511	60,755	1,697,365	28,007
Clams	[4] 134,495	74,743	[4] 117,251	54,059	[4] 68,969	34,036
Oysters:						
Eastern, market	[4] 56,900	24,386	[4] 61,042	26,161	[4] 55,492	23,782
Native, market	[4] 25	8	[4] 36	20		
Crabs	3,231,312	269,526	3,296,280	241,117	2,960,352	217,933
Spiny lobsters	1,486,406	289,785	1,175,223	163,182	1,490,958	275,351
Whale oil	1,525,733	111,887	1,980,068	112,917	5,165,930	326,975
Sperm oil	48,870	2,281	36,750	1,927		
Other whale products	1,108,833	24,675	882,760	20,902		
Miscellaneous products	4,345	632	1,461	498	2,963	394
Total	440,300,515	11,661,709	398,650,985	7,904,345	491,347,170	10,058,303

[2] Includes carp, catfish, croakers, dolphins, eels, horse mackerel, mullet, perch, Sacramento pike, rock bass, sculpin, sheepshead, skates, split-tails, suckers, surf fish, tom cod, white bait, and a few others.
[3] Weight of shells and meat.
[4] Weight of meat only.

Source: U. S. Bureau of Fisheries.

Yield of California fisheries, by groups, 1918–1927

Year	Cannery fish			Market fish		Miscellaneous fish products	Total, all products
	Tuna	Pilchard	Total	Finfishes	Shellfish		
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1918	18, 971, 071	157, 652, 811	176, 623, 882	82, 059, 248	4, 173, 012	51, 584	262, 907, 726
1919	41, 832, 676	153, 877, 179	195, 709, 855	62, 323, 460	7, 412, 459	4, 895, 571	270, 341, 345
1920	45, 685, 442	118, 520, 914	164, 206, 356	53, 586, 889	4, 236, 783	6, 930, 480	228, 960, 508
1921	21, 558, 566	59, 323, 305	80, 881, 871	48, 852, 576	3, 954, 934	2, 272, 035	135, 961, 416
1922	36, 900, 805	92, 114, 542	129, 015, 347	46, 764, 521	5, 295, 945	10, 051, 039	191, 126, 852
1923	39, 892, 984	159, 197, 006	199, 089, 990	49, 599, 185	6, 753, 022	7, 091, 174	262, 533, 371
1924	29, 365, 748	242, 685, 958	272, 051, 706	56, 428, 744	11, 706, 667	4, 708, 155	344, 895, 272
1925	54, 776, 970	315, 294, 986	370, 071, 956	58, 673, 005	8, 867, 773	2, 687, 781	440, 300, 515
1926	45, 895, 247	286, 741, 250	332, 636, 497	53, 421, 087	9, 692, 362	2, 901, 039	398, 650, 985
1927	70, 935, 766	342, 275, 289	413, 211, 055	60, 079, 974	12, 887, 248	5, 168, 893	491, 347, 170

Source: U. S. Bureau of Fisheries.

Yield of California fisheries, by groups, in 1927

Group	Pounds	Per cent of total	Value	Per cent of total
Sardines	342, 275, 289	70	$1, 826, 785	18
Tunas	70, 935, 766	14	3, 443, 717	34
Market finfishes	60, 079, 974	12	3, 708, 930	37
Shellfish	12, 887, 248	3	751, 502	8
Miscellaneous	5, 168, 893	1	327, 369	3
Total	491, 347, 170	100	10, 058, 303	100

Source: U. S. Bureau of Fisheries.

LOCATION OF FISHERIES

Marine fishing is carried on along the entire seacoast of California, although the San Pedro district, of which San Pedro is the principal port, is by far the most important in the amount and value of fishery products landed. (See fig. 2.) In 1927 this district accounted for 41 per cent of the total yield and 41 per cent of the total value, its pilchard and tuna fisheries being especially important.

Yield of California fisheries, by districts, in 1927

District	Pounds	Per cent of total	Value	Per cent of total
Northern	5, 321, 445	1	$445, 728	5
San Francisco	52, 551, 605	11	2, 013, 430	20
Monterey	186, 350, 813	38	1, 352, 768	13
San Pedro	202, 080, 546	41	4, 087, 896	41
Off California	171, 632, 995		2, 677, 150	
Off Mexico	30, 447, 551		1, 410, 746	
San Diego	45, 042, 761	9	2, 148, 481	21
Off California	13, 362, 571		478, 989	
Off Mexico	31, 680, 190		1, 669, 492	
Grand total	491, 347, 170	100	10, 058, 303	100
Off California	429, 219, 429		6, 978, 065	
Off Mexico	62, 127, 741		3, 080, 238	

Source: U. S. Bureau of Fisheries.

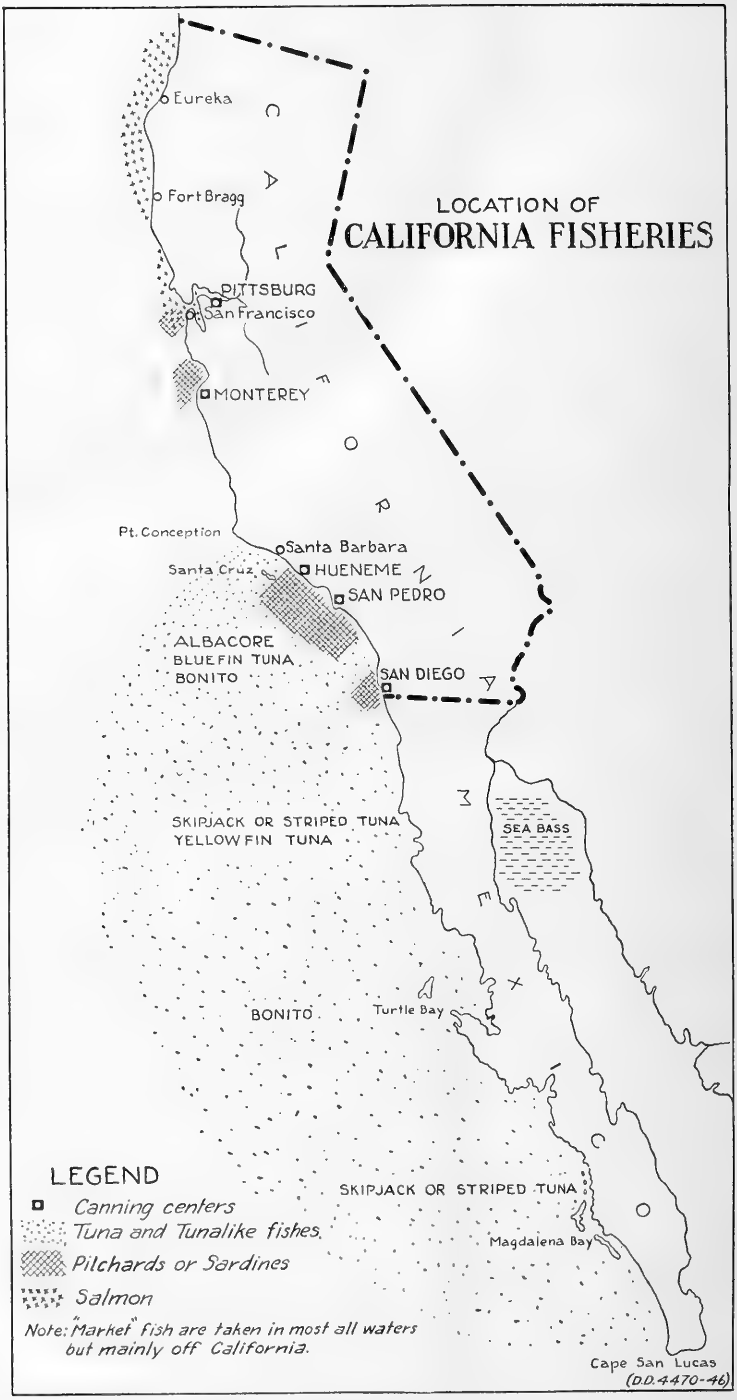

FIGURE 2.—Location of California fisheries

The importance of San Pedro as a fishing port is due to its proximity to the sardine-fishing area and to its facilities for unloading the catch and for harboring the vessels in safety. The city of Los Angeles' of which San Pedro is a part, recognized the possibilities and advantages of a fish harbor, with the result that special provision was made for such a harbor in the general port development. It was built at a cost of $1,875,000, has direct rail communication, is near a large city, is well sheltered, and has provision for future expansion. All necessary facilities for trade in fresh and frozen fish, salt fish, and by-products, as well as for the canning industry, are to be found in San Pedro.

A breakwater protects the harbor, thereby making safe the mooring and unloading of vessels. The harbor is located in the industrial section of San Pedro, at a distance from other commercial enterprises. At dead low water the soundings show 14 feet at the entrance and edge of the piers and 12 feet in the center of the harbor. Control is vested in the harbor department of the city of Los Angeles. There

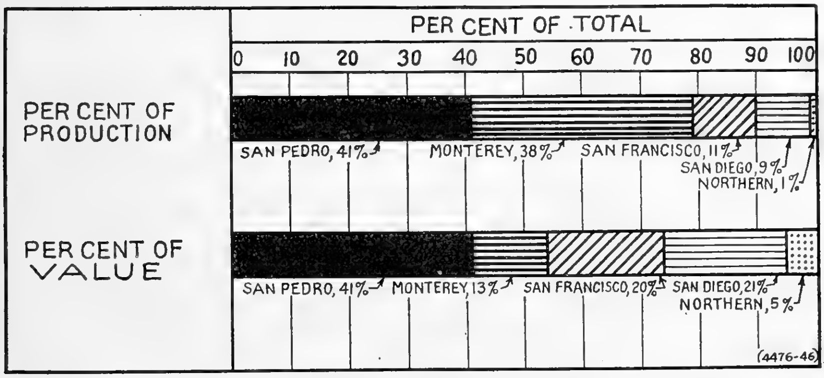

FIGURE 3.—Percentage distribution of California fish catch, by districts, 1927

are no restrictions except that dead fish and refuse must not be dumped in these waters.

Surrounding the harbor are canning and by-products plants, each of which is supplied with railroad spurs from the main track. Provision for the trade in fresh and frozen fish is also possible, but the companies engaged in this business are still all located across the harbor in San Pedro proper, on a municipal fish pier paralleling the harbor, where the market fishermen dispose of their catch to the wholesalers. There are 16 wholesale dealers located on this pier, of whom 2 are American, 3 Japanese, 4 Slovak, and 7 Italian.

In value to fishermen in 1927 the catch of the San Diego district, with San Diego as the principal port, ranked second. This district, important for its tuna fisheries, landed 9 per cent of the catch, and its value was 21 per cent of the total. Following closely is the San Francisco district, where San Francisco is the principal port. Here 11 per cent of the catch was landed, the value of which was 20 per cent of the total. The fisheries of this district are conducted primarily for several species of market fish, such as flounder, salmon, shad, and crabs. Monterey district was fourth in importance, with 38 per cent of the total catch and 13 per cent of the total value. Monterey, the principal port in this district, is especially important for its pilchard fisheries. The northern district is of least importance, with only 1 per cent of the total catch and 5 per cent of the total value. The salmon fisheries are most important there, and the principal ports are Fort Bragg, Eureka, and Requa.

In the northern, San Francisco, and Monterey districts the fisheries are prosecuted alongshore and in waters of the high seas adjacent to the United States. Thus, all the fish landed in these districts are a product of American fisheries. In the San Pedro and San Diego districts fishing is followed not only along the shores of the United States, but off the coast of Mexico. In 1927, 15 per cent of the catch landed at San Pedro and 70 per cent of that landed at San Diego, or a total of 62,127,741 pounds, were taken off the coast of Mexico. This is 13 per cent of the total quantity of fish landed in

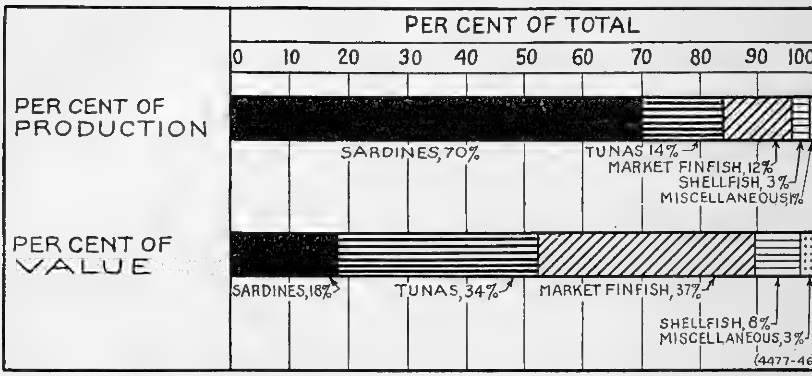

FIGURE 4.—Percentage distribution of California fish catch, by species, 1927

California. Practically the entire catch taken off the Mexican coast consisted of tuna and tunalike fish.

CANNERY FISH

During 1927 the fish-canning and fish by-products industries of California gave employment to 286 salaried officers and employees, who received $742,122; in addition, 3,755 wage earners—many of them women—were employed in the fish-canning establishments and received $2,824,680 in wages. This constitutes an average annual wage of $752. The salaried officers and employees are employed the entire year, while the wage earners are employed only during the canning season, which, in many instances, lasts only four or five months of the year.

In 1928 the value of all canned fishery products and by-products manufactured in California amounted to $23,901,587. In addition, there was a pack of mild-cured salmon and salted cod prepared, with an estimated value of $500,000, making the value of manufactured products in California about one-third of that of all fishery products manufactured in the United States during 1928.

Employment in California fish canning and preserving industry, 1927 [1]

Item	Number or amount	Item	Number or amount
Salaried officers and employees	286	Wages	$2,824,680
Salaries	$742,122	Average wage	$752
Average salary	$2,595	Value of canned products and by-products (1928)	$23,901,587
Wage earners (average number)	3,755		

[1] Represents only firms whose products are valued at $5,000 and upward.
Source: U. S. Bureau of the Census.

PILCHARDS, OR SARDINES

Pilchards, or sardines, are fished in California waters from the vicinity of San Francisco southward to San Diego. This fish is a pilchard (*Sardina caerules*), which is a true sardine in the sense understood by scientists and is very similar to the pilchards canned in Europe. Pilchards are surface swimming. Most of them are taken with lampara nets, although considerable quantities are taken in purse seines. Fishing is done at night, in the dark of the moon.

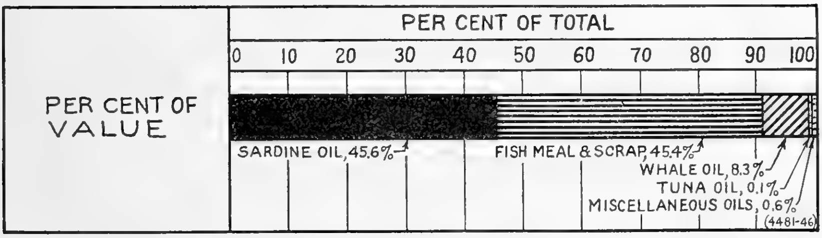

FIGURE 5.—Percentage distribution of California fishery by-products, 1928

The catch is made in the open ocean and in deep bays and inlets of the section, often within a few hundred yards of the cannery itself. The seasons are set by State law. In the vicinity of Monterey the season begins August 1 and runs to February 15. In the vicinity of San Pedro and San Diego the season begins on November 1 and continues through to March 31. The season for large fish in the vicinity of San Diego usually corresponds with the season in San Pedro, while that for small fish continues throughout the spring. The season at Monterey is at its peak in September and at San Pedro in February.

Most of the fishermen are Italians and Japanese, although there are considerable numbers of Austrians and Yugoslavs. During the off season considerable numbers of these, especially the Italians from the Monterey district, migrate to Alaska and enter the salmon fishery there.

During 1927 the catch of pilchards amounted to 342,275,289 pounds valued at $1,826,785 to the fishermen. This is the largest annual catch on record. Of the total production 51 per cent was taken in the Monterey district, 42 per cent in the San Pedro district, and the remaining 7 per cent in the San Francisco and San Diego districts.

Sardine pack in California, 1900–1928

Year	1-pound oval (48 cans)	1-pound tall (48 cans)	½-pound oval (48 cans)	½-pound square (100 cans)	¼-pound flat (100 cans)	¼-pound square (100 cans)	No. 10 round (6 cans)	Total	
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Value*
1900								[2] 388,992	$79,000
1904								[2] 206,016	(4)
1905								[2] 860,016	78,000
1908								[2] 1,634,016	207,000
1912	[1] 849,696		51,456					[3] 901,152	(4)
1913	[1] 3,536,928							[3] 3,536,928	(4)
1914	[1] 3,880,032							[3] 3,880,032	(4)
1915	2,096,544		15,912					2,112,456	238,973
1916	[1] 5,261,184		[1] 1,076,184		[1] 291,150			6,628,518	(4)
1917	[1] 24,004,992		[1] 12,877,656		[1] 3,731,600			40,614,248	(4)
1918	[1] 44,967,600		[1] 8,298,576		[1] 5,059,475			58,325,651	(4)
1919	[1] 46,332,576		[1] 2,498,064		[1] 2,054,450			50,885,090	(4)
1920								[3] 46,966,938	(4)
1921	18,236,544		272,568	29,300	62,125	522,325	12,928	19,135,790	2,346,446
1922	33,486,864	3,744	173,736	144,750		528,100		34,337,194	3,361,480
1923	51,907,872		154,344	111,750		633,550		52,807,516	4,607,931
1924	63,335,136		406,416	196,450		1,684,650		65,622,652	5,445,573
1925	80,531,328		723,816	348,000		712,675		82,315,819	6,380,617
1926	98,203,008		781,584	1,072,200		420,575		100,477,367	7,807,404
1927	115,300,608		924,336	5,852,850		953,225		123,031,019	9,268,784
1928	121,950,672	692,016	1,067,232	8,504,000		820,000		133,033,920	9,658,822

[1] May include a few other shapes.
[2] Various sizes not separated.
[3] Estimated.
[4] Data not available.

Source: 1912 to 1914 and 1916 to 1920, Pacific Fisherman; 1900, 1905, and 1908, Bureau of the Census; 1904, 1915, and 1921 to 1928, Bureau of Fisheries.

NOTE.—Figures in parentheses in box heads indicate number of cans to case.

The pilchard fishery has shown a phenomenal growth which resulted largely from the stimulation of demand for an inexpensive protein food during the World War. In the first few years of the postwar period production dropped off, but by 1923 equaled the output of 1918. Since then the production has gained rapidly, each year since 1923 exceeding the previous one except 1926.

Very few pilchards are sold fresh, most of them being used for canning as sardines. In 1928 the pack of canned sardines by the 28 plants in California amounted to 133,033,920 pounds valued at $9,658,822. This is the largest pack on record, both in quantity and value, and is 72 per cent of the entire production in the United States. (See table above and fig. 6.)

Because of the predominance of large fish in the catch, the canning of sardines in California is quite different from that of any other country. The pack consists mainly of fish canned in tomato sauce in 1-pound oval cans, which usually contain 4 to 10 large pilchards. In 1928 over 90 per cent of the production was so packed. The ½-pound square can was the next most important type of can, while the ½-pound oval, ¼-pound square, and 1-pound tall cans followed in order of importance. Sardines are packed in small cans mainly in the San Diego district, where juvenile pilchards predominate. These are generally packed in olive oil in cans of the key-opening type.

In 1928 the production of sardine meal and oil was valued at about $3,000,000.

To market the canned sardines the price has been lowered to such an extent that in many instances producers sell their pack at little more than the cost of production, the wholesale price to the canners being about 5 cents a pound. In retail stores one pays about 15 cents a pound for this product when packed in the 1-pound oval cans, obtaining about 1 pound of high-quality totally edible protein

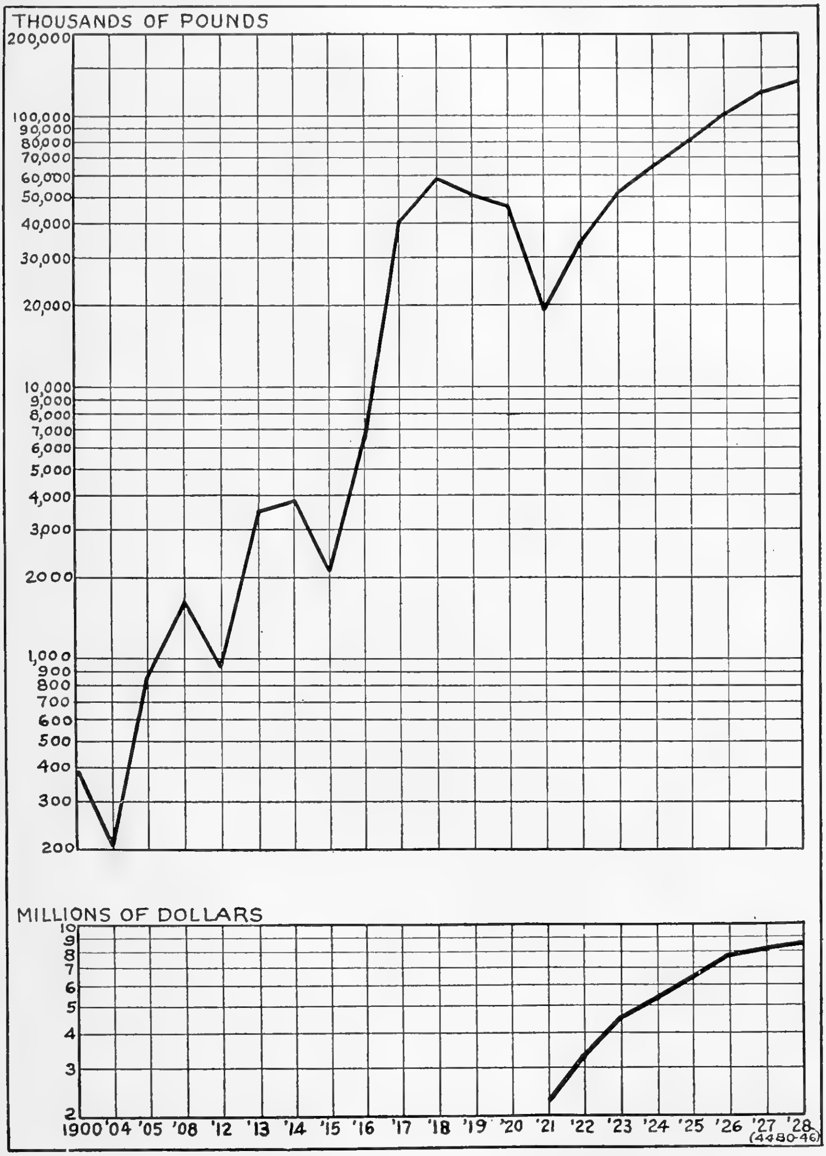

FIGURE 6.—Trend in production and value of California sardine pack, 1900–1928

food that is ready for immediate consumption or that will keep in any climate until used.

This low price has stimulated consumption in foreign markets, especially in the Orient. Roughly, about 50 per cent of the annual production is exported. In 1927 the value of the exports of canned sardines exceeded that of salmon, which has generally been our chief export fishery item. However, in 1928, salmon regained its previous place, exceeding by more than $1,000,000 the value of sardines exported.

The policy of selling California canned sardines at little more than cost no doubt has stimulated demand and has given them wide distribution, but it is a question as to how long this condition can exist. They will in all probability eventually be sold at a price based on a fair profit, which will tend to discourage their use for reduction purposes.

Canned sardines are marketed mainly through brokers, although many packers of specialties, such as kippered sardines and fillets of sardines, market their own product. Some of the packers are packaging their product in an attractive manner and are also conducting intensive advertising campaigns.

In an effort to stabilize the export trade the canners formed the California Sardine Export Association, which operated under the provision of the Webb-Pomerene Act. This association had its headquarters in San Francisco, where studies were made to learn the conditions surrounding the sale of California sardines in foreign countries. This lasted but a year or so and then dissolved. A new organization is now being formed to continue the work. It has been found that, in general, when California sardines are introduced into a foreign country they continue to be sold there. Orientals are especially fond of the product, and it can be purchased in Straits Settlements, China, Japan, the Netherland East Indies, Philippines, and other sections of the Far East. The oriental buyers want packs with 6 to 10 fish to the can, as venders in the Orient open the can and sell the fish one at a time.

The sardine packers are continually striving to improve their product. More sanitary methods have been adopted in the canneries, and the most modern labor-saving devices are installed. The packers themselves have set a high standard for their product. To continue the work of standardization a committee has recently been appointed by the Sardine Canners' Association of California to set rules for standardizing and bettering the pack. While the export market has been the most important, the product is gaining favor with the American public, especially the fancier packs put up in small cans. Trade is especially active in certain sections of New York City. Shipments to the Atlantic coast are usually made by water through the Panama Canal. These originate largely in San Francisco and Los Angeles.

TUNA AND TUNALIKE FISHES

The fishery for tuna and tunalike fishes (albacore, skipjack or striped tuna, bluefin tuna, yellowfin tuna, and bonito) is active over a strip of ocean for over 1,000 miles along California and off the Mexican coast from Point Conception in Santa Barbara County, Calif., to Cape San Lucas in Lower California. Some catches have been made as far south as Chile. Albacore and bluefin tuna are taken almost entirely off the coast of California, while the bulk of the catches of yellowfin and skipjack tuna are taken off the coast of Mexico. The bonito is native to the waters of both California and Mexico. These fish are taken with purse seines and hook and line, baited with live fish. Japanese fishermen have become the dominant factor in this industry, although the vessels fly the American flag.

In 1927 the total catch of tunas amounted to 70,935,766 pounds, valued at $3,443,717. (See fig. 1.) This is the largest catch on

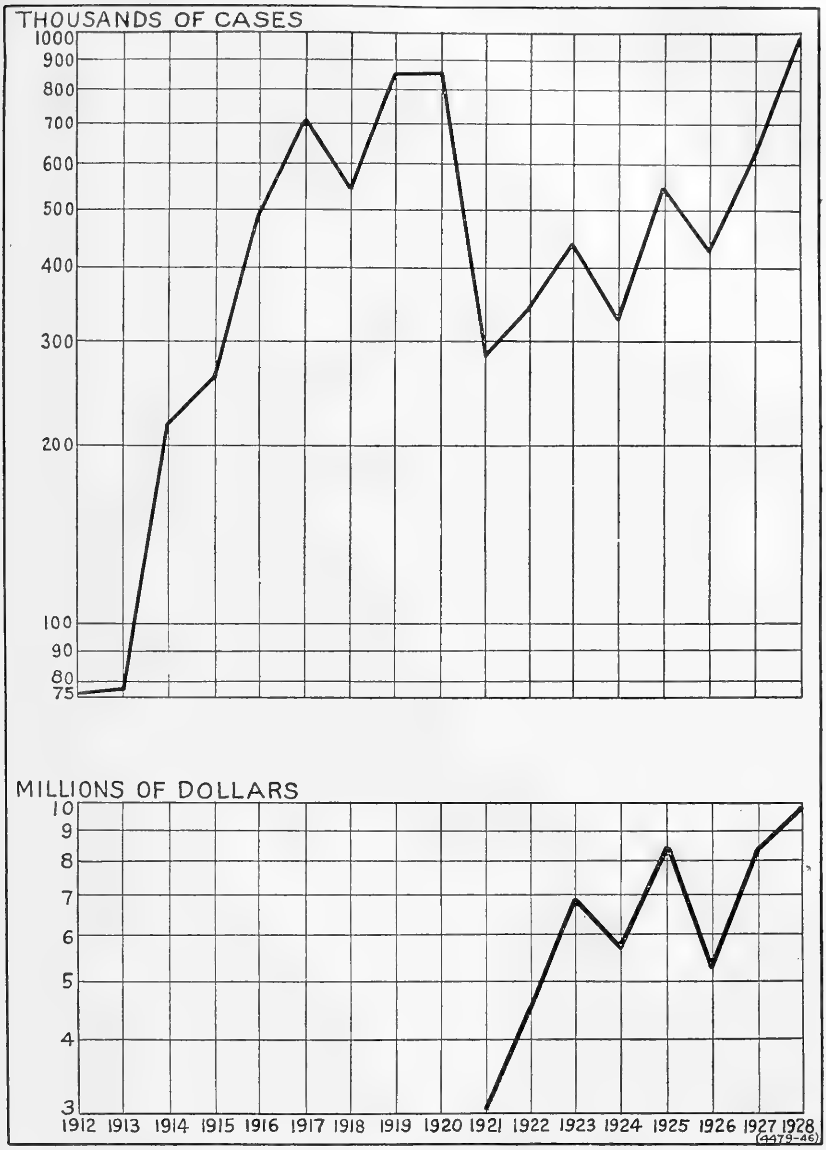

FIGURE 7.—Trend in production and value of California tuna pack, 1912–1928

record, although in keeping with the general upward trend in the catch since 1921. Of the total, 76 per cent was taken off Mexico and 24 per cent off California, thus indicating that the fishery is almost entirely dependent upon supplies obtained in distant waters. This condition did not always exist, for when this branch of the industry was established albacore and bluefin tuna were the species most sought. These were plentiful near the canneries, and the catch could be landed at the close of one or two days of fishing. However, the supplies of these species of fish became inadequate and other species of tuna were introduced which might be used for canning. The quest led the fishermen farther from port to points off the coast of Mexico, where the yellowfin tuna and skipjack or striped tuna could be taken.

At first the smaller vessels made the 1,000-mile trip to these fishing areas accompanied by large tenders, which supplied fresh water, provisions, bait, ice, and fuel to the small fishing vessels and also delivered their catch to the cannery. In this fishery by the smaller vessels it was necessary to clear from Mexican ports, whereby the Mexican authorities could require an export duty on the catch. To be relieved of the payment of this duty brought about a readjustment in the fishery, and larger vessels were outfitted so that it would be unnecessary to call at a Mexican port.

Many of the tuna vessels are now equipped with large bait boxes and with mechanical refrigeration to aid in holding the catch in prime condition. These vessels are able to clear from San Diego or San Pedro for the high seas, and they return to the home port only when a full load has been secured.

To supply the increasing demand of canneries, other sources of supply have been investigated. Importations of white-meat tuna have been made from Japan, where the dark meat is preferred. Quantities of tuna have also been received from Hawaii.

Very little tuna is marketed fresh or frozen. Formerly only the white meat was canned, but now the dark meat is being used for this purpose also. In 1928 there were 16 plants in California canning tuna. Their production amounted to 1,216,222 standard cases, on the basis of forty-eight ½-pound cans, valued at $8,374,030. This was one of the largest packs on record and constitutes about 90 per cent of the world pack. Other producing countries are Mexico (2 canneries), Hawaii (1 cannery), Italy, Portugal, Spain and France, and the Lybia region.

The most popular pack is the ½-pound can, in 1928 the pack of this size being valued at $5,464,275, or 65 per cent of the total value of tuna packed. The next most popular size is the ¼-pound round can, the production of which was valued at $1,505,246. The 1-pound round can is third in importance, and was used to can products to the value of $1,196,177. Tuna to the value of $208,332 was canned as "flakes" in various sizes of cans.

The production of canned tuna is marketed chiefly in the United States. The Mexican pack is marketed mainly in Mexico, although some is sold in the Orient, being shipped through California ports.

Pack of canned tuna, tunalike fishes, and mackerel in California, 1912–1928

Year	Albacore	Yellowfin	Bluefin	Mixed yellowfin and bluefin	Mixed yellowfin, bluefin, and striped tuna	Striped tuna	"Tonno," Italian style	Bonito
	Cases	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*
1915	258,427	----------	----------	----------	----------	----------	----------	----------
1916	96,186	----------	----------	----------	386,942	----------	----------	----------
1917	136,030	----------	----------	----------	522,836	----------	----------	----------
1918	82,801	----------	----------	----------	278,370	----------	----------	----------
1919	192,252	----------	----------	----------	550,130	----------	----------	----------
1920	(1)	----------	----------		835,645	----------	----------	----------
1921	344,117	----------	----------	56,577	----------	18,127	----------	----------
1922	272,563	----------	----------	164,617	----------	177,746	----------	10,591
1923	295,546	171,820	66,395	10,825	----------	89,893	131,745	14,683
1924	388,874	33,944	21,665	10,128	----------	43,205	177,049	20,558
1925	457,497	81,630	46,009	140,907	----------	163,919	245,084	12,377
1926	56,962	169,387	67,096	24,210	----------	272,690	256,028	49,334
1927	129,671	423,332	49,888	44,600	----------	406,056	208,287	23,800
1928	105,873	571,461	117,823	----------	34,516	199,803	231,486	23,157

Year	Yellowtail	Mixed yellowtail, bonito, and other canned products	Mackerel	Flakes	Total[2]		
	Cases	*Cases*	*Cases*	*Cases*	*Cases*	*Pounds*	*Value*
1912	----------	----------	----------	----------	[3] 75,900	3,643,200	(4)
1913	----------	----------	----------	----------	[3] 77,500	3,720,000	(4)
1914	----------	----------	----------	----------	[3] 217,000	10,416,000	(4)
1915	1,642	----------	----------	----------	260,069	12,483,312	$1,529,267
1916	----------	6,702	2,904	----------	490,734	23,555,232	(4)
1917	----------	24,674	17,886	----------	701,426	33,668,448	(4)
1918	----------	160,182	7,518	----------	525,871	25,241,808	(4)
1919	----------	89,580	9,410	----------	841,374	40,385,952	(4)
1920	----------	3,157	3,338	----------	842,140	40,422,720	(4)
1921	----------	----------	2,255	----------	279,292	13,406,016	3,085,956
1922	4,403	----------	----------	[5] 31,548	341,203	16,377,744	4,554,839
1923	7,704	----------	(4)	(4)	437,052	20,978,496	6,914,760
1924	13,329	----------	(4)	----------	326,208	15,657,984	5,756,586
1925	11,885	----------	----------	23,855	551,236	26,459,328	8,499,080
1926	20,014	----------	(4)	21,188	425,600	20,428,800	5,282,283
1927	40,061	----------	(4)	[6] 49,585	627,909	30,139,632	8,368,227
1928	14,288	----------	392,421	[6] 47,104	996,632	47,838,336	9,995,625

[1] Included under other heads.
[2] Totals are on the basis of forty-eight 1-pound cans to the case; the individual items include cans of all sizes.
[3] Detailed figures not available.
[4] Data not available.
[5] Includes fish flakes, abalone, mackerel, squid, and "tonno."
[6] Forty-eight ½-pound cans to the case.

Source: 1912 to 1920, except 1915, Pacific Fisherman; 1915 and 1921 to 1928, U. S. Bureau of Fisheries.

MACKEREL

The catch of mackerel (*Scomber japonicus*) in California rarely exceeded 4,000,000 pounds until 1928, when it is estimated that the catch amounted to about 35,000,000 pounds. This large production was brought about by the demand from the canning industry. It now seems likely that mackerel will become one of the stable cannery fishes of the State, and the production is expected to reach large proportions.

From time to time mackerel have been packed in an experimental way, but the production was never large. In 1928, however, 18 plants devoted their operations in whole or in part to the canning of mackerel. The production during that year amounted to 392,421

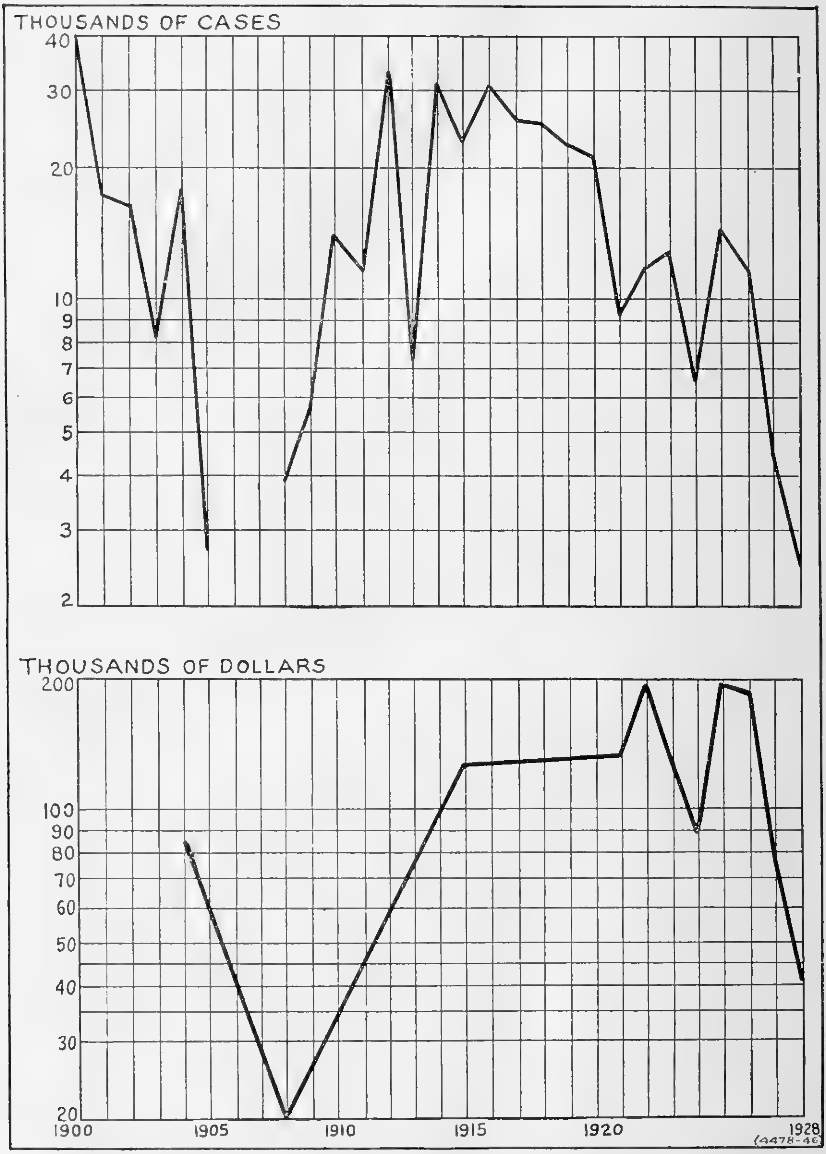

FIGURE 8.—Trend in production and value of California pack of canned salmon, 1900–1928

standard cases of forty-eight 1-pound cans, valued at $1,621,595. This represented 97 per cent of the entire United States production of canned mackerel, the remainder being packed in Massachusetts. This species is not seasonal in character, as mackerel seem to be found in abundant quantities throughout the year, making it possible to can them during the off seasons for sardine and tuna, thereby reducing the overhead expenses of the cannery. Formerly, mackerel were taken by hook and line, but now that greater quantities are necessary to satisfy demands by canners, the purse seine is being used. The canned product finds favor in oriental markets.

SALMON

Salmon, formerly one of the leading canning species of California fish, now find their chief demand as market fish.

The first salmon cannery on the Pacific coast was established in 1864 on a houseboat in the Sacramento River, near the town of Yolo. That year about 2,000 cases of forty-eight 1-pound cans were packed. During the following years canneries were established at other points in California and the fishery prospered, although no annual reported catch ever greatly exceeded 13,000,000 pounds. The largest production of canned salmon was reported in 1882, when 200,000 cases (on the basis of forty-eight 1-pound cans) were packed. Since then the production has steadily declined, that for 1928 barely exceeding 2,500 cases, valued at about $43,000.

The production of mild-cured salmon in 1928 amounted to 1,500,000 pounds, which is slightly smaller than that for the past several years. The largest pack on record was made in 1909, when about 5,000,000 pounds were packed. The product is packed in tierces holding about 800 pounds each. It is marketed in this and foreign countries.

Pack of canned salmon in California 1864–1928

Year	Northern California coast	Sacramento-Monterey district	Total		Year	Northern California coast	Sacramento-Monterey district	Total	
			Quantity	Value				Quantity	Value
	Cases [1]	Cases [1]	Cases [1]			Cases [1]	Cases [1]	Cases [1]	
1864	-----	2,000	2,000	[2]	1900	-----	39,304	39,304	[2]
1865	-----	2,000	2,000	[2]	1901	-----	17,500	17,500	[2]
1874	-----	2,500	2,500	[2]	1902	2,500	14,043	16,543	[2]
1875	-----	3,000	3,000	[2]	1903	-----	8,200	8,200	[2]
1876	-----	10,000	10,000	[2]	1904	3,400	14,407	17,807	$85,296
1877	8,500	21,500	30,000	[2]	1905	-----	2,780	2,780	[2]
1878	14,777	34,017	48,794	[2]	1908	-----	-----	3,938	20,000
1879	-----	13,855	13,855	[2]	1909	5,633	-----	5,633	[2]
1880	13,750	62,000	75,750	[2]	1910	14,016	-----	14,016	[2]
1881	-----	181,200	181,200	[2]	1911	7,604	4,142	11,746	[2]
1882	-----	200,000	200,000	[2]	1912	33,200	-----	33,200	[2]
1883	-----	123,000	123,000	[2]	1913	6,376	950	7,326	[2]
1884	-----	81,450	81,450	[2]	1914	14,000	17,315	31,315	[2]
1885	-----	90,000	90,000	[2]	1915	12,900	10,186	23,086	125,782
1886	-----	39,300	39,300	[2]	1916	11,389	19,445	30,834	[2]
1887	-----	36,500	36,500	[2]	1917	14,330	11,443	25,773	[2]
1888	6,747	68,075	74,822	$464,232	1918	21,100	4,036	25,136	[2]
1889	5,669	57,300	62,969	[2]	1919	19,597	3,169	22,766	[2]
1890	7,500	25,065	32,565	[2]	1920	20,628	427	21,055	[2]
1891	4,500	19,353	23,853	[2]	1921	9,296	-----	9,296	133,610
1892	4,250	11,634	15,884	75,696	1922	11,831	-----	11,831	196,310
1893	3,600	23,336	26,936	[2]	1923	12,822	-----	12,822	127,850
1894	3,700	28,463	32,163	[2]	1924	6,512	-----	6,512	89,136
1895	3,850	25,185	29,035	128,632	1925	14,543	-----	14,543	199,766
1896	-----	13,387	13,387	[2]	1926	11,761	-----	11,761	184,977
1897	-----	38,543	38,543	[2]	1927	4,581	-----	4,581	77,184
1898	-----	29,731	29,731	[2]	1928	2,522	-----	2,522	42,716
1899	3,850	30,330	34,180	159,468					

[1] Converted to the equivalent of forty-eight 1-pound cans to the case.
[2] Data not available.
Source: Pacific Fisherman; U. S. Bureau of Fisheries.

California pack of mild-cured salmon, 1900–1928

[In tierces, holding about 800 pounds]

Year	Klamath, Eel, and Noyo Rivers	Sacramento River	Monterey Bay	Total	Year	Klamath, Eel, and Noyo Rivers	Sacramento River	Monterey Bay	Total
1900		950		950	1915				[2] 2,200
1901		3,100		3,100	1916		650	1,069	1,719
1902		2,325	504	2,829	1917		1,508	300	1,808
1903		3,600	354	3,954	1918	455	1,913	266	2,634
1904				[1] 3,233	1919	1,326	2,355	1,055	4,736
1905		2,979	310	3,289	1920	1,463	1,345	330	3,138
1906	175	2,177	510	2,862	1921	1,050	812	201	2,063
1907	140	4,102	582	4,824	1922				[3] 2,163
1908		3,243	252	3,495	1923	1,126	606	103	1,835
1909	80	5,111	911	6,102	1924	2,619	1,291	5	3,915
1910		5,516	75	5,591	1925	1,965	1,523	276	3,764
1911	110	2,011	160	2,281	1926	929	1,767		2,696
1912	100	3,274		3,374	1927	895	1,125	32	2,052
1913		4,789	550	5,339	1928	1,686	179		1,865
1914		1,829	1,476	3,305					

[1] Value, $243,946. [2] Value, $187,220. [3] Value, $208,709.

Source: Pacific Fisherman, except for 1904, 1915, and 1922, which are from Bureau of Fisheries reports.

BY-PRODUCTS

The output of fishery by-products in California was valued at $4,022,642 in 1928. Under this designation are included fish meal and scrap; tuna, sardine, and whale oils; agar-agar; and other miscellaneous fishery by-products. Sardine oil was the most important item, the production being valued at $1,621,531. Next in importance was fish meal and scrap, the production of which was valued at $1,614,515. The products of the whale industry were valued at $296,000. The oils and meals are manufactured at the canneries from whole fish unsuitable for canning, from the surplus, or from offal. The whale products result from operations of whale fisheries. In 1928 one floating whaling factory was operated by California interests off San Clemente Island in southern California. Four killer boats worked with this factory, obtaining 304 whales, which produced 633,848 gallons of whale oil. This is a somewhat greater quantity than was produced for several years previous to 1928, but was less than that for 1922.

A large percentage of the fish meal produced is used as a constituent of poultry feed, most of it being marketed in California. The oils are used in the manufacture of paints and soaps, and some is hydrogenated into margarine for use in cooking. San Pedro and Monterey are the principal points for the production of fish meals, and sardine and tuna oils.

Production of certain fishery by-products in California, 1915 and 1921–1928

Year	Fish meal and scrap		Tuna oil		Sardine oil	
	Tons	Value	Gallons	Value	Gallons	Value
1915	995	$43, 505				
1921	15, 293	926, 020			170, 977	$35, 760
1922	10, 544	558, 642	86, 099	$23, 617	428, 859	145, 668
1923	10, 106	596, 082	3, 349	1, 198	284, 415	95, 711
1924	17, 813	833, 609	35, 408	10, 801	2, 338, 711	1, 076, 903
1925	22, 243	1, 084, 985	57, 825	14, 717	3, 082, 392	1, 551, 431
1926	16, 227	784, 694	24, 766	13, 771	2, 040, 500	904, 709
1927	[1] 21, 263	1, 134, 484	32, 895	8, 265	2, 514, 562	1, 116, 725
1928	[1] 26, 900	1, 614, 515	22, 834	5, 102	3, 825, 786	1, 621, 531
Per cent of total value		45. 4		0. 1		45. 6

Year	Whale oil		Sperm oil		Miscellaneous oils	
	Gallons	Value	Gallons	Value	Gallons	Value
1915					65, 567	$19, 548
1921					451, 770	123, 115
1922	915, 000	$366, 000	5, 050	$2, 525	33, 092	10, 508
1923	619, 239	316, 450	2, 078	1, 282	648, 764	310, 024
1924	390, 945	216, 350			25, 516	12, 758
1925	208, 348	104, 174	6, 500	2, 600	28, 119	11, 247
1926	264, 009	142, 917	4, 900	1, 927	48, 101	15, 474
1927	415, 000	208, 137			43, 140	12, 607
1928	633, 848	296, 000			44, 232	16, 626
Per cent of total value		8. 3				0. 6

[1] Includes some whale scrap.
Source: U. S. Bureau of Fisheries.

MERCHANDISING FISH TO CANNERIES

Fishing for cannery fish is conducted under three plans, namely, (*a*) by independent fishermen owning their own vessels; (*b*) by vessel owners employing fishermen for the operation of the vessel; and (*c*) by vessels owned by canneries. As a general rule, the vessels in the sardine fishery are owned by independent fishermen or vessel owners and in the tuna fishery the vessels are owned by the canneries.

The price to be paid fishermen and vessel owners for fish by the canners is determined at the beginning of each season by agreement between these parties. Canners owning their own vessels usually figure the cost of their fish at the price set by the above agreement. While the price of cannery fish at the cannery is set by mutual agreement before the opening of the fishing season, it sometimes happens that this price is changed during the course of the season if there occurs an unusual dearth or abundance of fish.

MARKET FISH

Market fish are all those species of finfishes which do not enter primarily into the canning trade—the salmon, shad, and mackerel being exceptions. The production of market species in 1927 amounted to 60,079,974 pounds. This was about a normal year's catch, and was 12 per cent of the entire production of all fishery products in California for 1927. The most important species in this group in 1927, ranked according to value, are the flounders or flatfish ("California halibut," sole, and other flounders), salmon, barracuda, rockfish, white sea bass or squeteague, yellowtail, shad, and mackerel.

LEADING SPECIES

Flounders.—The production of flounders, the most important market fish in 1927, from the standpoint of value, amounted to 13,068,555 pounds, valued at $730,812. This is an average production for the years since 1918. Flounders are taken primarily by vessels operating paranzella nets in the San Francisco district. They are marketed fresh or frozen. Quantities are filleted and packaged.

Salmon.—Until the World War gave an impetus to sardine and tuna canning the fishery for salmon (king and silver salmon) was the principal one in California. Now salmon ranks second in importance in value among the market fish. Prior to the war this fishery was conducted primarily to supply the salmon canneries of California. (See p. 357.) The fishery became depleted to such an extent that canning became of minor importance, and now most of the catch enters the fresh or frozen trade. Some of the fish are mild-cured. The catch in 1927, amounting to 6,511,929 pounds, valued at $644,175, was made largely in the Sacramento River and in the ocean touching Humboldt and Del Norte Counties. The bulk of the catch was taken with troll lines, but a small part was taken with gill nets.

Barracuda.—The catch of barracuda in 1927 amounted to 6,199,739 pounds, valued at $595,997. Practically the entire catch was taken in the San Pedro and San Diego districts, but a small portion was caught off the coast of Mexico. They are taken in purse seines, lampara nets, gill nets, and on troll lines. The catch is marketed mainly fresh or frozen, although some of the fish are canned, the production in 1928 being valued at $85,841.

Rockfishes.—The catch of rockfishes in 1927 amounted to 6,377,179 pounds, valued at $292,631. These fish are taken in every district, although most of the landings are recorded for the San Pedro district. They are taken by paranzella nets, lampara nets, gill nets, and lines. The catch is marketed fresh or frozen.

White sea bass or squeteague.—This species is found in every district in California from San Francisco southward, and off the coast of Mexico, although the bulk is taken in the San Pedro and San Diego districts. The catch, which in 1927 amounted to 2,273,407 pounds, valued at $217,744, is taken by means of purse seines, lampara nets, gill nets, trammel nets, and lines. These fish are marketed fresh or frozen.

Yellowtail.—The catch of yellowtail in 1927 totaled 4,224,853 pounds, valued at $195,463. These fish are taken in the San Pedro and San Diego districts, but principally off the coast of Mexico. Purse seines, gill nets, trammel nets, lampara nets, and troll lines are used. Some of the fish are marketed fresh or frozen but are used more extensively for canning. The output of the canned product in 1928 was valued at $79,523.

Shad.—The catch of shad in 1927 amounted to 4,103,423 pounds, valued at $148,201, although normally the annual catch ranges between 1,500,000 and 2,000,000 pounds. The entire catch was made in the San Francisco district by the use of gill nets. Shad are not native to California, but were introduced there by the United States Bureau of Fisheries in 1873. They were afforded wise protection and the production has steadily increased, that for 1927 being one of the largest on record and about one-fourth of the total yield of this species in the United States. Shad are marketed fresh, frozen, and canned. Considerable quantities of the fresh and frozen stocks are shipped to Atlantic coast cities. In 1928 there were 8,917 cases of forty-eight 1-pound cans of shad packed in California, which represents about a normal pack for recent years. This is 32 per cent of the entire production of canned shad in the United States.

California (Sacramento River) pack of canned shad[1] 1914–1928

Year	Cases [2]	Year	Cases [2]	Year	Cases [2]
1914	500	1918	5,806	1925	8,724
1915	8,578	1919	4,721	1927	8,692
1916	27,653	1920	4,390	1928	8,917
1917	24,048	1924	3,000		

[1] Includes shad roe.
[2] Forty-eight 1-pound cans to the case.
Source: Pacific Fisherman.

Totuava or "Mexican bass."—This fishery is followed mainly by Mexicans and Indians in the Gulf of California, and it is discussed here because the fish are marketed chiefly in San Pedro although considerable quantities are marketed in San Francisco. Originally this fishery was conducted for the sound, or swim bladder, which when dried brought high prices in oriental markets. Now the meat is saved, especially during seasons when catches of market fish at San Pedro are small. The fish are trucked by Mexicans to the border, at Calexico or Yuma, where they are purchased by Americans and collected into larger lots; then they are washed, weighed, and packed aboard refrigerated motor trucks and conveyed across the desert of Lower California to San Pedro, a distance of 230 miles. The trip takes about 15 hours and is usually made during the night. Trucks leaving the border in the evening have the fish at the San Pedro market early next morning. Some carload shipments have been sent direct to San Francisco from Guaymas. According to statistical records of the State of California the American importation of totuava now amounts to about 2,000,000 pounds annually, whereas in 1923 imports of only about 75 pounds were reported.

MERCHANDISING MARKET FISH TO WHOLESALE FISH DEALERS

Market fish are brought to port and sold by fishermen to the wholesale dealers marketing fresh and frozen fish. In 1929 there were 78 wholesale establishments, 30 wholesale branches, and 15 brokers and buyers in the business. Many fisherman belong to trade organizations which aid them to merchandise their catch. In San Francisco the catch is marketed mainly through the San Francisco Crab Fishermen's Association. In addition to marketing crabs this association also markets rockfish, salmon, and bait fish taken by its members. In marketing the catch to wholesalers that of the various members is pooled each day and prorated to the wholesale houses in San Francisco. No dispute arises over this distribution, as the percentage allowed each wholesaler is agreed upon at a meeting of the wholesalers and association each year. The association also controls the amount of the catch. It is familiar with the wholesalers' needs in San Francisco and makes an effort to supply them, but is careful not to have a surplus.

Salmon is marketed on a seasonal contract basis, while the prices for other species vary from day to day. Practically all the fishermen operating out of San Francisco belong to this association.

Market fish landed at San Diego are sold to the local wholesale establishments through the San Diego Fishermen's Association and the American Fishermen's Protective Association. Upon arrival at port with a fare the captain of the vessel notifies the officers of his respective association of its amount. The price to be paid the fisherman by the wholesalers is then determined by the officers of the association, after due consideration is given to the landings at this port and the prices current at San Pedro. After the price is determined the fare is unloaded at the wholesale establishment purchasing it. No regulations are effective regarding the catch each member is allowed to take each day, and at times the market may be glutted. During the course of a day an unusual number of fares may be landed, and, in order to move them, the later arrivals are sold at a lower price than that offered for a fare arriving earlier in the day, in which case the last price governs the selling price of fares sold earlier in the day. When fish are scarce the fishermen's organizations prorate the landings among the wholesalers according to the percentage they usually purchase. When prices drop below 3 cents a pound on any one variety of fish, a portion of this variety, if suitable, is diverted to the salt-fish trade, in order to hold up the price for the fresh stock.

There are no fishermen's selling organizations in San Pedro, each captain disposing of his fare to the local distributor who will pay the highest price. To market a large fare it is sometimes necessary to divide it among several wholesalers. While cannery fish and market fish are disposed of by fishermen through two channels, the fisherman with his stock of gear is able to fish for practically every species. His decision as to which species to fish is governed by the price he can get. Some fishermen will fish for cannery fish when they are running good and the price is high. In the meantime if market fish are more valuable they will fish for those species. However, as a general rule, fishing is done for cannery fish when they are in season and for market fish at other times of the year, although some engage in the market fishery the year round.

After purchase by the wholesalers the fish are washed, packed, and iced. Shipping containers are usually boxes—some new, while others have been used for the shipment of other merchandise. As a rule these containers are of no standard dimensions.

The principal markets for fresh and frozen fish of California origin are in San Francisco and Los Angeles, although distribution is quite well effected throughout the smaller towns of the State. A few shipments are forwarded as far east as Texas and Kansas, but this business has not been developed to any great extent. The following figures from the Bureau of Agricultural Economics shows the amount of fish frozen in California in 1928, by species and by months.

FISH FROZEN IN CALIFORNIA, BY SPECIES, 1928

	Pounds
Cod, haddock, hake, pollock, etc	134, 841
Mackerel (except Spanish)	450, 934
Sablefish (black cod)	112, 938
Salmon:	
Silver	359, 707
Pink	131, 769
All other	359, 292
Shad and shad roe	6, 957
Shellfish	554, 748
Miscellaneous	2, 124, 907
Total	4, 236, 093

FISH FROZEN IN CALIFORNIA, BY MONTHS, 1928

Month ending the 15th of—	Pounds
January	389, 399
February	694, 208
March	292, 847
April	199, 168
May	440, 832
June	369, 050
July	195, 412
August	228, 733
September	251, 448
October	298, 559
November	361, 521
December	514, 916
Total	4, 236, 093

Monthly holdings of frozen and cured fish in California, 1928

Holdings on the 15th of—	Frozen fish	Cured fish	Holdings on the 15th of—	Frozen fish	Cured fish
	Pounds	*Pounds*		*Pounds*	*Pounds*
January	1, 632, 107	475, 937	August	1, 226, 422	559, 265
February	1, 668, 824	414, 790	September	1, 209, 171	751, 125
March	1, 540, 511	452, 215	October	1, 244, 769	728, 650
April	1, 045, 430	437, 407	November	1, 305, 978	534, 974
May	1, 133, 416	440, 531	December	1, 437, 425	558, 096
June	1, 281, 985	265, 588			
July	1, 261, 151	827, 679	Average monthly holdings	1, 332, 266	537, 188

Source: Bureau of Agricultural Economics.

The shipping of fresh and frozen fish from California to interior points has been hindered by methods of handling and shipping, but this situation is being remedied. Some firms are preparing and marketing fish fillets. These are wrapped in vegetable parchment paper, packed in tin cans, well iced, and shipped in wooden boxes. This type of pack has become popular with California retailers, and the future should show extensive developments along this line.

The advancement of the fresh or market fish industry in California, especially at San Pedro and San Diego, has been retarded somewhat by wide fluctuations in prices paid by wholesalers to fishermen. The State Fish Exchange is making an effort to remedy this situation in an effort to stabilize the industry.

RETAIL SALE OF FRESH AND FROZEN FISH

In 1929 the retail sale of fresh and frozen fish in California was conducted by 125 fish dealers who handle fish exclusively, 175 fish peddlers, and 3,200 who handle it as a side line to other merchandise.

According to the California State Fish Exchange, about 40 per cent of the trade in these stores is done on Friday, and the average dealer sells fish only three days a week. Over 90 per cent of the trade is in four species—salmon, halibut, sole, and barracuda—while rockfish, bass, cod, and tuna represent 5 per cent of the trade. Only about 15 per cent of the fish marketed in the retail stores is sold in the form of fillets. The State Fish Exchange also has learned that the sale of fish is hindered to a great extent by the relatively high price, this being attributed to a demand for certain species of fresh fish when out of season in California or for species of which there is a small catch. The former might be remedied by freezing stocks at times when the supply exceeds the demand, for distribution in the off season.

To counteract this situation the exchange is attempting to acquaint consumers with the large variety of California fish available and with the times at which they are in season. This is being accomplished by radio talks, newspaper publicity, exhibits, and by the publication of a sea-food cookbook. Consumers have been especially eager to obtain copies of the cookbook, demonstrating that there is a great interest in sea foods which can be made a source of profit to retailers if the dealers exhibit a like interest and handle these products on a par with other products rather than as a side line.

WAREHOUSING FROZEN FISH

There are eight cold-storage warehouses in California that provide for the storage of frozen fishery products. Two of these are located in San Francisco, 1 at Pittsburg, 2 at Sacramento, 2 at Los Angeles, and 1 at Long Beach. These plants are able to store about 3,000,000 pounds of fishery products at a time, and, according to reports, this can be increased if business warrants. The two plants at San Francisco, the one at Pittsburg, one of the two at Los Angeles, and the one at Long Beach freeze in addition to storing fishery products. These plants are able to freeze about 82,500 pounds in 10 working hours.

Most of these storage plants are less than a mile from local express terminals, while all except one have spur tracks from the main railroad line leading directly to the doors of the plant. These spur tracks can accommodate 62 cars.

The plant at Pittsburg is located on a pier where fishing vessels can unload directly into the warehouse, and one of the plants in San Francisco is located about one-half block from the water front. The remaining six plants are located at some distance from the water front; thus in most cases fish landed by vessels must be transported overland from the pier to the cold-storage warehouse.

Rates for storing frozen fish vary from 25 to 50 cents a month for each 100 pounds. Three firms charge 25 cents a month per 100 pounds; two firms, 30 cents per 100 pounds if received frozen, and 50 cents per 100 pounds if the fish is to be frozen in the plant; and three firms charge 50 cents per 100 pounds for the first month's storage and 33⅓ cents per 100 pounds for each succeeding month.

During 1928 the freezing plants in California froze 4,236,093 pounds of fishery products, consisting mainly of salmon, shellfish, and mackerel. This is only about 4 per cent of the total quantity of fish frozen in the United States during 1928.

Monthly holdings of frozen fish in 1928 ranged from 1,045,000 pounds to 1,669,000 pounds, the smallest amount being held in April and the largest in February, and averaged about 1,332,000 pounds. Holdings of cured fish each month in 1928 ranged from 414,790 pounds in February to 827,679 pounds in July and averaged about 537,000 pounds.

Fish rapidly frozen and packaged as fillets have lately been introduced in California. This product is frozen and packed at plants on the east coast, transported in mechanically refrigerated freight cars, and marketed at retail stores in its original frozen condition. As yet no local establishments have begun to freeze and package fillets or other fish products, although several firms prepare and market fresh fillets and other package products.

SHELLFISH

The shellfish group includes abalone, octopus, squid, shrimp, clams, oysters, crabs, and spiny lobsters. California is the only State having an abalone fishery. The production of all these species in 1927 amounted to 12,887,248 pounds, valued at $751,502, or about 3 per cent of the entire yield of the California fisheries that year. This was the largest catch on record. Practically the entire catch is made in the San Francisco and Monterey districts. In point of value, spiny lobsters were most important and crabs next, followed by abalone.

Crabs and spiny lobsters are marketed fresh cooked. Large quantities of the meat of crabs are sold by retail establishments in the form of cocktails. At the fish wharf in San Francisco there is a row of these establishments where each has a cooking vat on the sidewalk in front of the store. Here the crabs are cooked immediately upon landing; the meat is picked out and is then ready for serving.

Both the meat and the shell of the abalone are utilized. The meat is marketed fresh although some is minced and canned, the production of the latter in 1928 being valued at $3,520. The shells are used for the manufacture of curios. Octopus and squid are dried and marketed chiefly to the oriental trade. Some squid is canned, but the production is small. Shrimp is marketed both fresh and dried; the dried shrimp being sold mainly to the oriental trade. Clams and oysters are marketed fresh. The catch of native oysters is negligible. Mature eastern oysters are transplanted to beds in the vicinity of San Francisco, where they are held pending sale. The eastern oyster does not reproduce in California waters.

ALASKAN FISHERIES

SALMON FISHERY

Interests operating salmon-canning plants in Alaska have their headquarters in San Francisco. Each season 4,000 to 5,000 men work at these canneries, being employed largely through the Alaska Fishermen's Union in San Francisco. The union has a contract with the canners which covers the wages, living conditions, hours of labor, and other matters pertaining to the employment and well-being of its members. The season in Alaska usually lasts during the four to five summer months of each year. Therefore, laborers hiring out for this work find it necessary to obtain employment in other lines during the winter months. Some follow fishing upon their return to California, while others work as sailors, longshoremen, or ship riggers, or find employment in steel construction and other lines. The crews leave San Francisco about May 15 and return during the latter part of August or the first week in September. Most of the fishermen are Italians, although there are considerable numbers of Finns, Norwegians, and Swedes. The cannery employees are generally Japanese, Chinese, Filipinos, and Mexicans.

Practically all the supplies for these canning operations in Alaska are purchased in the State of California, and are loaded on the company's vessel at San Francisco for transportation to Alaska. The pack is brought to San Francisco and distributed from there.

COD FISHERY

A fishery for cod off the coast of Alaska in the northern Pacific is conducted by interests operating from San Francisco, where the boats are outfitted and from which port they sail. The season in Alaska lasts through the summer months, although the schooners sail from port some time in the spring and return in September. Four vessels were engaged in this fishery in 1928.

The cod are immediately salted aboard vessel or at shore stations in Alaska, barreled, and then brought to San Francisco for manufacture at the plants of the fishing interests into various salt codfish products. The landings of salt cod in California during 1928 amounted to 1,898,106 pounds, valued at about $115,000. This represents the landings of only three vessels, as the fourth vessel to sail in 1928 was wrecked on its return voyage, with a loss of about 1,000,000 pounds of salt fish.

The fishery for cod from California ports has been conducted since 1863 although it never gained much prominence, the annual landings of salt cod at San Francisco rarely exceeding 5,000,000 pounds. The markets for salt cod products are on the Pacific coast and in several of the Western States, the west coast of South America, the Hawaiian and Philippine Islands, and to some extent in Straits Settlements.

Catch of cod by California fishermen in Okhotsk and Bering Seas and North Pacific Ocean, 1863–1928

Year	Vessels engaged		Fishing grounds	Catch		
					Dry salted	
	Number	Net tonnage		Number	Pounds	Value
1863	1	120	Okhotsk Sea	7,100	22,483	
1864	2		Okhotsk and Bering Seas	54,500	218,000	
1865	7	449	Okhotsk Sea and North Pacific	225,000	700,000	
1866	16	1,689	do	724,000	2,080,000	
1867	20	2,083		934,400	3,140,000	
1868	10	1,502	Okhotsk Sea and North Pacific	580,000	2,026,000	
1869	21	2,669		1,032,000	3,440,000	
1870	24	3,376	Okhotsk Sea and North Pacific	1,467,000	4,218,000	
1871	16	2,224	do	926,000	2,572,000	
1872	7	793	do	305,500	1,000,000	
1873	12	1,274	do	563,000	1,832,000	
1874	8	606	North Pacific	369,000	1,270,000	
1875	9	847	do	362,000	1,680,000	
1876	13	1,387	Okhotsk Sea and North Pacific	814,000	2,526,000	
1877	16	2,276	do	779,000	2,500,000	
1878	21	2,232	do	902,000	3,968,000	
1879	12	1,858	do	1,301,000	4,690,000	
1880	8	1,597	do	1,203,000	3,608,000	
1881	8	1,597	do	1,061,000	3,182,000	
1882	13	2,383	Okhotsk and Bering Seas and North Pacific	1,241,000	3,722,000	
1883	17	3,260	do	1,720,000	5,160,000	
1884	16	3,513	Okhotsk and Bering Seas	1,622,000	4,866,000	
1885	12	2,347	Okhotsk and Bering Seas and North Pacific	1,374,000	4,122,000	
1886	11	2,418	do	1,222,000	3,692,000	
1887	8	1,704	do	1,107,000	3,386,000	
1888	8	1,581	do	1,036,000	3,160,000	
1889	6	1,097	Okhotsk Sea	462,134	1,463,424	$36,587
1890	3	715	Okhotsk and Bering Seas	562.951	1,782,679	44,567
1891	6	1,232	do	646,708	2,047,911	51,393
1892	5	1,335	do	718,284	2,274,565	56,864
1893	6	1,460	do	556,000	1,760,667	
1894	5	1,393	do	589,000	1,865,167	
1895	6	1,518	do	879,016	2,783,550	83,506
1896	6	1,512	do	618,000	1,957,000	
1897	5	1,393	Bering Sea	554,000	1,754,333	
1898	3	780	do	292,000	924,667	
1899	5	1,174	do	1,868,568	5,917,131	178,054
1900	6	1,305	do	623,000	1,972,833	
1901	6	1,540	do	702,000	2,223,000	
1902	9	2,034	do	933,000	2,954,500	
1903	8	1,899	Okhotsk and Bering Seas	1,037,300	3,284,783	
1904	7	1,939	Okhotsk and Bering Seas and North Pacific	1,775,667	5,622,944	131,516
1905	11	2,928	Okhotsk and Bering Seas	1,336,133	4,231,088	
1906	11	3,237	do	1,478,000	4,680,333	
1907	8	2,400	do	741,800	2,349,033	
1908	7	2,259	do	910,000	2,881,667	
1909	5	1,416	do	600,000	1,900,000	
1910	3	1,074	Bering Sea	380,000	1,203,333	
1911	3	993	do	439,000	1,390,167	
1912	5	1,554	Bering Sea and North Pacific	664,000	2,102,667	
1913	5	1,554	do	717,000	2,270,500	
1914	6	1,783	do	931,202	2,848,806	
1915	7	2,175	do	1,564,008	4,952,692	161,695
1916	4	1,695	North Pacific	1,127,000	3,568,833	
1917	7	2,392	do	1,352,000	4,281,333	
1918	6	2,034	do	1,488,321	4,713,018	
1919	8	2,387	do	658,800	2,086,200	
1920	11	2,597	do	781,200	2,473,800	
1921	3	464	do	254,333	805,383	
1922	4	1,116	do	530,526	1,680,000	84,000
1923	8	2,645	do	441,474	1,398,000	69,900
1924	6	1,872	do	910,746	2,884,028	190,041
1925	4	1,544	do	1,078,613	3,415,608	237,724
1926			do	1,172,233	3,712,070	235,055
1927			do	867,436	2,746,880	186,644
1928			do	599,402	1,898,106	

Source: Pacific Cod Fisheries; U. S. Bureau of Fisheries.

CALIFORNIA DEPARTMENT OF NATURAL RESOURCES

The fishery resources of the State of California have been declared the property of the State, and their taking and manufacture is regulated by acts of the legislature through the department of natural resources.

The division of fish and game of the department of natural resources is interested in the fisheries and licenses anglers, commercial fishing, and fish-manufacturing establishments, and regulates their operations. In addition, this division collects statistical data on the commercial fisheries and prepares this information in such a form that the real abundance of the fisheries can be determined. These statistical data are obtained by reports from the fishermen, wholesale establishments, and canneries, and cover such information as size of catch, method of capture, where taken, where landed, production of manufactured products, and other similar information.

Statistical reports of this nature enable the division to have on file facts to be used as a basis for wise legislation. Further, these statistical reports are of economic importance to the trade and serve as a basis for their operations.

The division also makes biological studies of the important fisheries, the most conspicuous of which during recent years has been the study of the sardine fishery. These studies guide the type of statistical information requested of the trade, determine measures to restrict fishing operations, and assist to enlarge a fishery where this may be done without danger to the supply.

For the conduct of its investigations pertaining to fish the division operates a modern, up-to-date laboratory at Terminal, Calif. This is the base for the operations of the statisticians and biologists of the State fisheries.

GAME FISHING

The place of the game fishes, particularly the trouts, in the Southwestern States is of some importance. In these States the presence or absence of trout fishing is to a considerable extent correlated with altitude. An altitude of 5,000 feet upward, whether it be in Arizona or northern Idaho, will generally signify the presence of snow-fed streams, whose low temperatures will support trout. Consequently, in spite of the preponderance of arid country in Arizona, New Mexico, and parts of Utah and Nevada, the mountain streams and the larger permanent water courses in the lower altitudes will afford excellent trout fishing for the native western cutthroat, rainbow, and introduced brook trout. California offers advantages for fine trout fishing.

In many sections of the Pacific Southwest the relative inaccessibility of the fishing waters has prevented overfishing, and consequently the angler will enjoy better sport than in the more populous sections which are easily reached.

While warm-water game fish of the type of bass and others are not native to many of the watersheds in the Southwest, they have been introduced in several sections and have become well established, so that waters which would otherwise be devoid of food or game fish are now capable of furnishing an immediate supply of both. The large irrigation reservoirs in Colorado, Nevada, Utah, and the other States have been stocked with bass, catfish, and similar species and furnish an abundant supply of these varieties. The Elephant Butte irrigation project in New Mexico, and other developments on a smaller scale, have provided artificial lakes which will not support trout but which afford the proper conditions for an abundance of the so-called warm-water or pond fishes.

The stocking of lakes and streams by State and Federal hatcheries is being constantly augmented, and in spite of the somewhat reduced mileage of streams in comparison with many other regions, sport fishing is sufficiently attractive in the greater part of the area under discussion to demand the attention of anglers.

That sport fishing is of importance in the section is evidenced by the fact that annually these States license over 472,000 anglers and sport fishermen, over one-half of whom are licensed in California.

According to the latest report available 47 State fish hatcheries (of which 26 are in California) are operated in the States comprising the Southwestern section. The annual output of these is about 47,000,000 eggs, fry, and fingerlings, and consists mainly of various species of trout, although there was a considerable production of salmon in California. In addition, the United States Bureau of Fisheries operates five fish hatcheries in the section. These have an annual output of nearly 24,000,000 eggs, fry, and fingerlings, which consist mainly of chinook salmon and various species of trout.

FISH MEAL IN ANIMAL FEEDING, WITH BIBLIOGRAPHY[1]

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United States Bureau of Fisheries

CONTENTS

INTRODUCTION

There are two important steps in the obligation of the research worker in making known to the general public the results of his work so that the greatest benefit from his efforts may accrue to mankind. The first is the formal publication of his report or manuscript so that his coworkers may collaborate with him. The second obligation is to publish the practical aspects, the possibilities, and the potential benefits to civilization which may be developed from the knowledge made available by his work. Many scientists unintentionally neglect this second phase in their responsibilities to the public. Many excellent scientific accomplishments have remained buried in some archive or storehouse of science, locked from public use, until a coworker comes along, appreciates the value of the work, and makes it known to the public.

Therefore, the purpose of this publication is to give a review and bibliography of the researches and present scientific knowledge—both American and foreign—in the field of the experimental feeding of fish meals and shellfish meals to laboratory and farm animals, including noncritical comments on the results of these researches. Every effort has been made to condense the contents and to make this treatise concise. The details, except the very essential ones of

[1] Appendix XII to the Report of the U. S. Commissioner of Fisheries for 1930. B. F. Doc. 1090. Submitted for publication July 9, 1930.

the many experiments conducted by numerous investigators, have been omitted, for to burden the reader with such a mass of material would defeat the purpose of this publication.

This report is intended not only for the scientist or biochemist, but also for the animal feeder and for those engaged in the production of fish meals and shellfish meals.

Marine products are an extremely important potential source of numerous nutritional requirements in the dietary of man and his domestic animals. These products of the sea are valuable for their vitamin potency, protein content of a high cofficient of digestibility, and for their quantity and variety of mineral constituents. The diversification of mineral content may be realized and emphasized by calling attention to the fact that scientists have found in sea water at least 34 elements useful to life. Much research remains to be done to determine the rôle played by minerals in nutrition; in fact, this field of nutrition has hardly begun to be investigated. However, outstanding examples of the importance of obtaining knowledge along these lines are the demonstration of the rôle played by copper and iron in one type of nutritional anemia, and iodine in the prevention and cure of simple goiter. Marine products offer the richest known sources of materials for these mineral studies in the science of nutrition. This should appeal especially to scientific investigators. It can not be too emphatically stated to workers in the science of nutrition that here lies a pioneer field of potential investigation offering rich rewards and a veritable "gold mine" of possibilities in scientific accomplishment.

Fish meals and shellfish meals are manufactured as by-products from the waste or inedible parts of fish and shellfish accumulating in large quantities at various concentration points of our fishery industries. Some fish meals, such as the menhaden, are produced from whole nonedible fish. If the fish or fish waste contains much oil, it is both cooked and pressed and the remaining so-called "green" scrap is dried and ground. In certain localities in Maine the oily herring scrap is dried directly without cooking or pressing. If the waste is low in oil, as is the case with the waste accruing in some of the North Atlantic fisheries, it is either directly dried and ground, or cooked, pressed, dried, and ground. Processes of drying vary considerably in different plants. In general, the meal may have been dried either by solar evaporation, hot air or hot furnace gases, or by steam heat with or without reduced pressure. The Bureau of Fisheries is very much interested at present in investigations of the relative nutritive value of fish meals produced by various methods of drying. Scientific data, so far available, seem to indicate that there is a wider variance in the nutritive value of the same sources of material prepared according to different processes of drying than there is in the nutritive qualities of meals prepared from different species of fish by the same type of dryer.

Fish meals may be divided into two general classes according to their oil content; namely, oily fish meals and nonoily fish meals. Oily fish meals may be considered as those prepared from fish in which the oils are distributed generally throughout their bodies, whereas nonoily fish meals come from fish whose oils are concentrated mainly in their livers. A certain amount of prejudice has grown up in the trade regarding the term "oily" as applied to fish meals. "Oily" fish meals have been considered inferior products, but this prejudice is unfounded and misunderstanding exists as to the true value of good oily fish meals. An oily fish meal properly prepared is a product of unexcelled feeding value among sources of animal proteins.

Oily fish meals are relatively high in oil or fat and somewhat lower in protein content than nonoily fish meals. Nonoily fish meals are very low in content of oil or fat and as a rule relatively high in protein content. There is some evidence resulting from recent scientific research to indicate that nonoily fish meals may be best suited to some farm animals and that other farm animals may give more economical returns on oily fish meals.

Some of the important fish meals and shellfish meals from the standpoint of commercial production and potential availability in quantities, together with 1929 statistics, are given in the following table:

Production of scrap, meals, etc., in United States and Alaska, 1929

Products	Tons
Dried scrap and meal:	
Fish—	
Ground fish (sources of white fish meal)	13,298
Herring, Alaska	12,750
Herring, sea and alewives (Atlantic coast)	3,373
Mackerel	497
Menhaden	33,041
Pilchard	36,500
Salmon	2,427
Tuna	6,186
Dried scrap and meal—Continued.	
Fish—Continued.	
Whale, meat and bone	1,415
Miscellaneous	1,944
Shellfish—	
Crab, king and blue	1,468
Shrimp	2,153
Acidulated scrap, menhaden	23,089
Crude and green scrap, miscellaneous	4,540
Total	142,681

It should be noted that a few of the items appearing in the above table such as crude, green, and acidulated scrap, are not suitable for animal feeding as now prepared. A different process or further steps would have to be undertaken to render them useful for such purposes. However, they do represent potential sources of feed concentrates. Acidulated scrap is diverted into fertilizer stock.

ACKNOWLEDGMENTS

The author wishes to acknowledge his indebtedness to the usefulness of the excellent scientific abstracts contained in the "Experiment Station Record," published by the office of experiment stations of the United States Department of Agriculture, Washington, D. C., and the "International Review of Poultry Science," Rotterdam, Holland. These abstracts are so comprehensive, and at the same time concise, that their equal could not be duplicated, and in some instances all or parts of some of them were used in this publication.

GENERAL FEEDING VALUE

Under the general feeding value of fish meals and shellfish meals, the following subjects are discussed: Superiority of fish meals over other feed concentrates; growth-promoting properties of fish and shellfish meals; effect of fish meal feeding on milk production, on butterfat content of milk, on egg production, on slaughter records of swine, and on odor of milk, eggs, and meat; effect of fish meals high in salt content on farm animals; palatability of fish meals; digestibility of fish meals; and amounts of fish meals which should be fed in the rations of various animals.

SUPERIORITY OF FISH MEALS OVER OTHER FEED CONCENTRATES

In surveying the literature in this field, the reader will find that there are 21 references [2] which report that fish meal gave better results and more economical gains in feeding farm animals than did tankage or meat meal, whereas there are only 3 references [3] which reported the superiority of tankage or meat meal over fish meal in this respect. There are 6 references [4] reporting these feeds on an equal basis. Four references [5] stated that fish meal gave better feeding results than cottonseed meal; 3 references [6] reported superiority of fish meal over soybean meal; 2 [7] showed fish meal to be better than peanut feed or peanut cake; 2 [8] indicated better returns from fish meal than those obtained from linseed meal; 1 [9] reported fish meal superior to alfalfa meal; 1 [10] obtained greater gains with fish meal than with a basal ration of bran and middling; 1 [11] said fish meal was better than decorticated cotton cake; 1 [12] reported fish meal as superior to coconut meal; 1 [13] stated fish meal's superiority over corn meal; 1 [14] reported greater gains with fish meal than with oat meal; 1 [15] obtained more economical gains with fish meal than with buttermilk or with condensed milk; and 1 reference [16] said fish meal and soybean meal were about equal in feeding value. One investigator [17] said that fish meal gave better results than any available vegetable protein concentrates unless the vegetable proteins were supplemented with minerals, in which case they were about equal in feeding value.

Rosenfeld (1906) reported that fish was equal to beef as a source of energy in the diet and that eating fish caused a secretion of less uric acid than was the case in eating meat.

Morgan (1914) said that fish meal was being extensively used in Germany as a supplementary feed for cattle, hogs, and poultry.

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[2] Kleeman, 1910; Martinoli, 1914; Ashbrook, 1917; Weaver, 1920; Hackedorn, 1922; Hostetler, 1922; Scott, 1924; Straight, 1923; Blair, 1923; Scott, 1925; Godbey and Durant, 1926; Kaupp and Dearstyne, 1926; Edwards, 1929; New Jersey Station Report, 1928; Manning, 1929d; Hackedorn and Sotola, 1922; Henry and Morrison, 1923; Evvard, 1929, 1930, 1930a; Feedstuffs, 1930.

[3] Kaupp, 1927; Templeton, 1927; Clayton, 1927.

[4] Kaupp, 1924, 1925; Helyar, 1925, 1926; Kaupp and Dearstyne, 1926; Livesay and Stillwell, 1928.

[5] Weber, 1916; Woodward, Converse, Hale, and McNulty, 1924; Scott, 1927; Clayton, 1927.

[6] Ruffner and Curtis, 1925; Ellington and Knott, 1928; Robertson and Baskett, 1929.

[7] Paterson, 1920; Woodward, Converse, Hale, and McNulty, 1924.

[8] Scott, 1924; Hackedorn and Sotola, 1922.

[9] Scott, 1927.

[10] Crowther, 1916.

[11] Paterson, 1920.

[12] Hackedorn and Sotola, 1922.

[13] Green and Richardson, 1924.

[14] Green and Richardson, 1924.

[15] Kaupp and Dearstyne, 1926.

[16] Ellington and Knott, 1928.

[17] Davidson, 1928.

Weber (1916) stated that "the universally favorable results obtained in the feeding of fish meal appear to warrant its extended use as a supplementary feeding stuff."

Hostetler and Halverson (1927) fed fish meal to swine with excellent results. Fish meal gave satisfactory results in experimental feeding at the South Carolina Agricultural Experiment Station (1928).

GROWTH-PROMOTING PROPERTIES OF FISH MEALS

The Live Stock Journal (1913) stated that fish meal is used in Germany and Scandinavia as a food for dairy cows, and for fattening bullocks and pigs, with excellent results on their productive powers. Cattle may be fed a daily allowance of from 2 to 2½ pounds, and pigs about one-half pound.

SWINE

Kleeman (1910) said that fish meal was better and gave greater gains than meat meal in swine feeding.

According to Martinoli (1914), pigs fed on fish meal grew more rapidly than those fed on meat meal, and they were of superior quality. Fish meal was valuable in developing the skeleton and in stimulating the appetite and the processes of assimilation, from the earliest age of the pigs.

In feeding tests with pigs, as reported by Crowther (1916), gains were greater with fish meal than on basal ration of bran and middlings.

Ashbrook (1917) conducted feeding experiments with swine at the United States Department of Agriculture, Bureau of Animal Industry experimental farm located at Beltsville, Md., in which he demonstrated that pigs made greater gains on fish meal than on tankage.

Templeton (1920) reported that menhaden fish meal, which was furnished by the United States Department of Agriculture, proved to be a palatable feed and gave satisfactory gains when fed to swine.

According to Weaver (1920) fish meal produced greater gains in weight, on less feed consumed, than did tankage. Swine which were fed fish meal produced an average daily gain of 1.76 pounds per head and required only 4.41 pounds of feed per pound of gain in weight, whereas those fed tankage produced only 1.45 pounds of average daily gain in weight per head and required 5.17 pounds of feed per pound of gain.

Hostetler (1922), in feeding swine, found that fish meal, as a supplement to corn, showed greater gains than tankage.

Landis (1923) said fish-meal feeding increased the gains in weight of swine slightly, and also improved slightly the quality of the carcasses.

According to Green and Richardson (1924), fish meal fed in comparison with corn meal to young pigs not only produced greater gains in weight on less feed consumed, but cured lameness in the control lot and prevented lameness in the fish meal lot. These investigators also demonstrated that fish meal produced greater gains in weight on a smaller feed requirement than oatmeal.

Paterson (1925) reported that fish meal gave satisfactory gains.

In feeding experiments with swine, Scott (1924) demonstrated that fish meal as a supplement to corn in the ration was superior to tankage and linseed meal. The tests indicated that corn alone is not an economical feed for fattening purposes, while fish meal proved to be a highly desirable supplement. In 1925, the same investigator in swine-feeding tests obtained an average daily gain of 0.7 pound on the corn and fish-meal ration and obtained only 0.42 pound of daily gain on the corn and meat-meal ration. Not only that, but the amount of feed required per unit of gain was 50 per cent greater on the corn and meat-meal ration than was required on corn and fish meal.

Ruffner and Curtis (1925) found that fish meal produced more rapid and economical gains than soybean meal, in supplementing corn for fattening pigs.

Investigating fish meal and tankage as sources of protein in feeding tests with swine, Helyar (1925) reported that the group fed tankage on rape pasture made an average daily gain of 2.06 pounds while those fed fish meal made a comparative gain of 1.41 pounds. But, in the dry lot, the pigs fed tankage made only 1.63 pounds of average daily gain, while those fed fish meal under the same conditions made a comparative gain of 1.96 pounds.

In comparing the effect of fish meal and tankage on the rate of growth and on the texture and quality of the carcass of swine (Helyar, 1926), the results were found to be about equal.

Scott (1927) fed the pigs in one group a ration of 9 parts of corn to 0.75 part of fish meal. Another group received 9 parts of corn to 0.75 part of cottonseed meal and 0.5 part of alfalfa meal. The fish-meal lot produced an average daily gain of 0.65 pound per head, against 0.3 pound per head for the other group. Furthermore, the second group required about 2.2 times as much feed to produce 100 pounds of gain as did the fish-meal group.

In an effort to find satisfactory supplementary feeds for swine being fattened on pasture (de Ruyter de Wildt, 1928), two trials were conducted using two lots of 12 pigs each, averaging 22.33 kilograms (49.1 pounds) per head in the first test and 20.7 kilograms (45.5 pounds) each in the second test. The basal ration consisted of barley, whey, and dicalcium phosphate, and the experimental lot received in addition to the basal ration 150 grams of fish meal in the first test and 200 grams in the second test. The average daily gains were 0.495 and 0.524 kilograms per head in trial 1, and 0.46 and 0.485 kilograms per head in trial 2 in the respective lots. In the second test the value of the results was somewhat obscured by the fact that 1 pig from lot 1, and 3 from lot 2 had to be discarded. While the addition of fish meal increased the rate of gain, it also increased the cost of gains to a point where it was not economical. There was no significant difference in the quality of carcasses produced in the various lots. The cured hams had no off flavors or taste, nor was there any difference in the quality of the hams from the various lots.

According to Templeton (1927), "marine tankage," a by-product of the fish industry was compared with "digester tankage," using 2 lots of 16 pigs each, averaging 68.5 pounds per head. Corn and "digester tankage" were fed in lot 1 and corn and "marine tankage " in lot 2. The average daily gains during the 101-day feeding period were 1.58 and 1.34 pounds per head, respectively. The feed consumed per 100 pounds of gain was 352 pounds of corn and 20.9 pounds of " digester tankage " in lot 1, and 389 pounds of corn and 25.2 pounds in lot 2 of " marine tankage."

The following is quoted from the 1928 report of the New Jersey Agricultural Experiment Station: " For each 100 pounds of gain pigs fed corn supplemented with fish meal required 359 pounds of feed, while those receiving tankage instead of fish meal required 402 pounds of feed. Pigs in the first lot gained at the rate of 1.48 pounds and those in the second lot 1.33 pounds per head daily."

According to Hostetler and Halverson (1928) pigs averaging 42 pounds per head were divided into 3 lots of 15 head each and fed a mixture of corn meal, wheat shorts, fish meal, and minerals. The protein content of the ration was decreased as the pigs increased in live weight. Lot 1 was fed in dry lot and lots 2 and 3 on orchard grass pasture, but in the latter lot only half as much shorts and fish meal was fed as in the other lots. Death losses of 5 pigs in lot 1, 3 in lot 2, and 4 in lot 3 made the results somewhat unsatisfactory. The average daily gains in the respective lots were 1.23, 1.25, and 1.2 pounds per head, and for each 100 pounds of gain the respective lots required 362, 363, and 375 pounds of feed.

Nance (1928) reported that the rate of gain, feed consumption, and cost of gain were practically the same in two lots of pigs, one of which received shelled corn, fish meal, and minerals and the other fish meal and cottonseed meal, equal parts, instead of fish meal alone. In the latter lot, 26 pigs were fed the cottonseed-meal supplement for 153 days without any apparent harm.

Nance (1928a) fed shelled corn and minerals to two lots of 8 pigs each, averaging approximately 100 pounds per head. In addition to this basal ration, lot 1 received fish meal and lot 2 whale meal as protein supplements. The average daily gains were 2.04 and 1.28 pounds per head in the respective lots. Lot 1 required approximately 100 pounds less feed to produce 100 pounds of gain than did lot 2. Both lots consumed about the same amount of protein supplement, but lot 2 ate 3.7 times as much mineral and 153 pounds less of corn than lot 1.

The American Fertilizer (1929) in commenting on swine-feeding tests at the Georgia Agricultural Experiment Station, stated that Edwards obtained 123.3 pounds of gain in 57 days on fish meal and only 99.1 pounds of gain on digester tankage. The comparative figures on cost were $7.49 to $8.48, favoring the fish meal.

Manning (1930) reported that the addition of 10 per cent of fish meal to the ration produced excellent results in swine feeding.

The following three paragraphs are abstracted from the North Carolina Agricultural Experiment Station report, dated June 30, 1928:

North Carolina (1928) stated that 4 groups of 15 pigs each were self-fed corn, fish meal, and minerals. In group 3 ground soybean hay and in group 4 ground alfalfa hay replaced one-fourth of the fish meal. The mineral mixture was composed of 10 pounds of ground dolomitic limestone (except in lot 2, which received calcitic limestone), 10 pounds of superphosphate, and 2 pounds of salt. The average daily gains in the respective lots were 2.36, 2.54, 2.31, and 2.4 pounds per head, while the feed required per 100 pounds of gain was 371, 356, 391, and 368 pounds in the respective groups.

North Carolina (1928a) said that, on 3 acres of standing corn, 66 pigs averaging 41 pounds per head and self-fed fish meal and mineral in addition gained 640 pounds of pork per acre. The estimated yield was 29.7 bushels of corn per acre, and the 3 acres furnished feed for the pigs for 32 days.

For hogging down immature corn (North Carolina, 1928b), 66 pigs were turned into an 11.85-acre field when the corn was in the dough stage. They were self-fed fish meal and minerals as supplements. It required 48 pounds of fish meal, 7.6 pounds of minerals, and 1 acre of corn to produce 283 pounds of gain.

In this connection, it is well to quote from Evvard (1929):

We have computed a test in which we compared 60 per cent protein tankage with 54 per cent menhaden fish meal in the balancing of corn for young growing pigs in dry lot feeding. These pigs were carried from the 60-pound weight until they went over the scales at 225 pounds. The check group of pigs receiving corn, self-fed, and tankage, self-fed, block salt being allowed free-choice style, made an average daily gain of 1.59 pounds per pig and the feed required for the 100 pounds of gain amounted to 353 pounds of corn and 34 pounds of high-protein packing-house tankage. The total feed requirement therefore was 387 pounds of feed per hundredweight of gain produced.

On the other hand, where menhaden fish meal was fed in the same manner as the tankage along with corn the showing was better on the whole. These pigs took 354 pounds of corn and 28 pounds of fish meal per hundred pounds of gain made. The total therefore amounted to 382 pounds. The fish-meal fed pigs gained practically the same or 1.55 pounds per head daily.

But the fish-meal pigs ate less fish meal out of the self-feeder than did those pigs across the fence which got tankage. The average daily tankage consumption was 0.53 pound, as contrasted with 0.45 for the fish meal. The difference is quite considerable, amounting to approximately 15 per cent, the fish-meal pigs eating that percentage less of supplementary high-protein feed than did the tankage ones.

Since the corn-consumption requirement was so close in both groups the big difference therefore was in the supplement consumed, 100 pounds of the fish meal going as far as 121 pounds of the 60 per cent protein tankage.

In figuring the protein consumed per hundred pounds of gain put on we find that the tankage-fed pigs took 55.7 pounds, this counting the protein in the corn as well as in the tankage. On the other hand, the fish-meal fed pigs took only 50.5 pounds of total protein for the hundredweight of pork made or a difference of 5.2 pounds of protein, which was saved by the fish product fed pigs. In round numbers, the protein saved by the fish meal, therefore, amounted to close to 10 per cent.

Twelve American experiments have been run with fish meal in comparison to high-protein tankage and in 11 out of 12 of these trials the fish meal produced larger and more economical gains.

In these 12 trials the pigs averaged approximately 75 pounds when the experiment started and the days fed, figured approximately in months, close to three. The average daily gain with tankage and corn was 1.43 pounds per pig, as contrasted with 1.58 pounds when fish meal was allowed. Here we have a difference of practically 10 per cent in the gains, in favor of the fish-meal feeding. The feed required for the hundred pounds of gain produced on corn and tankage added up to 435 pounds, on the average, whereas with fish meal and corn it was 401 pounds, a saving of 34 pounds of feed on this amount of gain. This is equivalent to approximately 8 per cent saving in feed.

And what is more important, the pigs receiving fish meal took not only less corn, but also less supplement. On corn and tankage the corn requirement amounted to 398 pounds and the tankage figured 37 pounds. With fish meal, however, the corn requirement was only 369 pounds, combined with 32 pounds of fish meal.

Here we have practically 8 per cent less corn required when fish meal was consumed, and also 13 per cent less fish meal than of tankage.

Considering the whole matter in another way we find that in these 12 tests 100 pounds of fish meal was equivalent in feeding value to 117 pounds of tankage plus 91 pounds of corn. If we convert these figures into dollars and cents, charging the corn at 84 cents the bushel and the tankage at $4 the hundredweight, 100 pounds of fish meal was worth $6.04. The fish meal was worth approximately $2 per hundredweight more than the tankage, or practically 50 per cent more.

The above figures are applicable to those conditions under which one is feeding pigs in dry lot and using either one of these two animal source supplements to balance the corn. Of course if the fish meal or the tankage is combined with other feeds in such a manner as to make a high-class protein supplement then we would not expect nearly so much difference between the tankage and the fish meal.

Naturally if one is buying fish meal for feeding purposes, the higher the protein content, other things being equal, the greater should be the value per bag.

And fish meals which carry as much as 3, 4, or 5 per cent salt, especially the latter figures, are likely to be worth less than similar fish meals carrying 1 per cent salt or less. Salt is a splendid feed for pigs, but if it is fed in too large quantities it detracts from the gains and increases the feed requirement. If one has too much salt in the fish meal or other protein supplement which he feeds, then he is forcing the pigs to take more salt than they require for normal body functioning; hence there is a detraction from the efficiency of the feed.

There isn't any question but that high-grade fish meal is a splendid feed for pigs as well as poultry, and judging from the above figures one can certainly pay more for the fish meal than he can for straight 60 per cent protein tankage, even though the fish meal runs only 55 per cent protein or so.

Evvard and others (1930) said:

The high protein regular fish meals prepared from haddock (69.2 per cent protein), menhaden (58.8 per cent protein), and herring (68.24 per cent protein) proved superior to tankage in margins per pig, particularly per month on the basis of feed prices charged in this experiment. Fish meals of high quality produced by the right kind of drying and manufacturing process should logically be looked on with much favor when one is seeking a superior animal source supplement for corn balancing. Comparative cost prices as well as feeding value should of course be given due consideration in making selections.

A high bone and relatively low protein fish meal is much better adapted to the fortification of supplemental mixtures of vegetative source feeds than as a lone supplement to corn.

The Canadian source fish meal "Fasterfat" with 64.12 per cent protein fed to Lot G did not give as good results as tankage. The relatively short showing of this Canadian meal may be accounted for by the relatively high price for the distantly secured product as well possibly as to the particular method of manufacture used in its preparation. We need to know more about the relative efficiency of the different drying systems used in the making of dry fish meal from naturally wet fish and fish by-products inasmuch as there are indications that some processes produce a better final product than others even though the same raw material is used.

Cod-liver meal was fed to Lot K in order to test its palatability and generally wholesome qualities when consumed in relatively large amounts. From these standpoints this meal showed up very well although financially, largely due to the high price of the meal ($130 a ton), the feeding of this by-product of cod-liver oil manufacture, as a lone supplement to corn, proved inadvisable. The addition of 2, 3, or 4 per cent to perhaps as high as 8, 9, or 10 per cent of a vitamin D potent cod-liver meal to suitable supplemental blends should prove efficacious in many cases not only for the bone growth vitamin standpoint but also from the protein quality viewpoint.

According to Evvard and others (1930a):

All of the fish meals used excelled meat meal tankage as lone supplements to corn in daily gains, feed consumption, and feed requirements for the dry lot fattening of spring pigs. The "Canadian source" fish meal was the least efficient of the three fish meals fed. The menhaden and haddock fish meals (Lots II and III) fed in place of tankage reduced the feeding costs materially, on the basis of feed prices charged in this experiment, and increased the margin per pig over feed costs. The Canadian fish meal, Fasterfat (Lot IV) made a relatively poor financial showing. Since nutritious fish and fish products were used in the making of this Nova Scotia fish meal the method of manufacture may have possibly had a destructive effect on certain nutritional elements therein such, for instance, as on the vitamins or protein building stones.

The full replacement of the meat meal tankage of the Trinity mixture with each one of the three fish meals used, resulted in substantially greater gains (thus causing a marked saving in the feeding time required to reach the 225 pound marketable weight), lessened supplement consumption per pig daily and per hundred pounds gain, decreased total feed requirements, lowered cost of gains, based on feed prices used, and enhanced financial returns (measured by margins per pig per month or for entire feeding period). The straight menhaden and haddock fish meals led.

The full replacement of the meat meal tankage of the "Big 10" mixture with different fish meals did not yield the markedly beneficial results manifested in the modification of the Trinity mixture—thus indicating in another fashion that the "Big 10," nutritionally speaking, is superior to the simple Trinity supplement. However, the incorporation of two of the fish meals, menhaden and haddock, proved efficient, the cost of gains being lowered and the margins per pig increased. Less supplement was consumed per pig daily and per hundred pounds gain produced in all three fish-meal lots (compared IX with X, XI, and XII).

The combination of both fish meal and tankage in providing the "animal source" feeding products proved more efficacious than dependence on either one of these two high-class zoological products. The incorporation of equal quantities of meat meal tankage and fish meal in the "Big 10" rather than the use of only one of these showed up advantageously from the nutritional and financial standpoints in that the gains were augmented, the feed requirements lessened, the cost of gains decreased and the "dollars and cents" margins per pig enhanced. Again we find that the fish meal made from the straight haddock source (Lot XIV) and the straight menhaden source (Lot XIII) showed superior to the white fish source product from Nova Scotia (Lot XV).

By including the combination of the mammalian and land source meat meal tankage with the piscatorial and ocean source fish meal in the "Big 10" supplement we therefore have what we now designate and name "The Big 11 Supplement" which is a superior one. The "Big 11" supplement, on this basis, would be compounded as per the following formula:

The "Big 11" Supplement

	Pounds
Meat meal tankage, 60 per cent protein	20
Fish meal, 55 per cent or more protein	20
Linseed-oil meal, 34 per cent protein	15
Cottonseed meal, preferably 43 per cent protein	20
Peanut-oil meal, not less than 40 per cent protein	9
Alfalfa meal, high grade, green and leafy	12.8
Salt	1
Limestone, 95 per cent or better calcium carbonate	1.5
Iron oxide, ferric grade	0.198
Wood ashes, hardwood	0.5
Potassium iodide	0.002

In purchasing a supplement for corn balancing in the production of pork on foot one must ever consider both nutritional and economic efficiency in order to garner the largest possible profit from the feeding operation. The relative cost prices of the supplements under consideration must be weighted alongside their nutritive worth in making the most efficient and profitable purchase.

The following is quoted from pages 652 and 653 of Henry and Morrison (1923):

Though fish meal has for years been fed to stock in Europe, only recently has it been thus used in the United States. The composition of the better grades of fish meal is quite similar to that of digester tankage. Fish meal from various sources varies more or less in composition and quite probably in feeding value. Recent experiments have shown clearly that high-grade fish meal is even superior to tankage as a supplement to the grains in swine feeding. The following table summarizes the results of 11 trials in which fish meal has been compared with tankage as supplement to corn for pigs in dry lot. The fish meal was in most cases the by-product of oil extraction from menhaden herring caught off the Atlantic coast. A total of 145 pigs, averaging 77 pounds in initial weight were fed for an average of 80 days in these trials.

Fish meal vs. tankage as supplement to corn for pigs[1]

Average ration	Daily gain	Feed for 100 lbs. gain	
		Corn	Fish meal or tankage
	Pounds	*Pounds*	*Pounds*
Lot I, fish meal, 0.48 lb.; corn, 5.7 lbs	1.58	370	33
Lot II, tankage, 0.49 lb.; corn, 5.6 lbs	1.42	403	37

[1] Hostetler, N. C. Station (information to the authors); Morrison and Bohstedt, Wis. Station (unpublished data); Robison (Ohio Bul. 349); Starkey, S. C. Station (Information to the authors); Vestal, Ind. Station (information to the authors); Wilson and Kuhlman (S. D. Bul. 192); Ala. and Tenn. Stations (Data from U. S. D. A.).

In 10 out of the 11 trials fish meal produced larger and more economical gains than tankage. On the average the pigs fed fish meal gained 1.58 pounds a head daily and required only 370 pounds corn and 33 pounds fish meal for 100 pounds gain, while those fed tankage gained 1.42 pounds and consumed 403 pounds corn and 37 pounds tankage for each 100 pounds gain. In the majority of other trials in which fish meal has been compared with tankage in various rations, it has also proven superior, but in a few instances tankage has been the more valuable.

In experiments at the South Carolina Agricultural Experiment Station in which protein supplements were studied for fattening purposes, pigs hand-fed a combination of fish meal and soybean meal as a protein supplement made an average daily gain of 1.81 pounds per head at a feed cost of $7.42 per 100 pounds of gain, while a combination of fish meal and cottonseed meal fed in the same manner produced a gain of 1.76 pounds per head at a cost of $7.71 per 100 pounds. When the cottonseed meal combination was self-fed free-choice, faster and more economical gains were obtained than with the soybean-meal mixture. In a comparison of hand and free-choice feeding of corn and fish meal in dry lot and on forage, the most rapid and economical gains were obtained by the use of the free-choice method. Forage increased the daily gains per head from 1.56 to 1.75 pounds, and reduced the cost of 100 pounds of gain from $7.88 to $7.09.

As an illustration of the growing interest in fish meal for feeding farm animals, the following is quoted from Feedstuffs (1930):

The value of fish meal as a feed for swine was stressed by W. L. Robison, of the Ohio experiment station, when he discussed feeding experiments carried on at the station during the past year. Mr. Robison's talk was a part of the program of Livestock Day, held at Wooster, Ohio, on April 25. A feature of the meeting was the presence of many feed dealers in addition to several hundred farmers. The feed dealers were especially invited, as those in charge of the station feel that their education in proper feeding methods is of prime importance to the farm prosperity of the State.

Mr. Robison, who was in charge of the hog-feeding experiments, said that the most important fact brought out by his work was that fish meal should be considered in the hog ration. The lots where corn, fish meal, and salt were fed put on gains at a lower cost than those fed on rations which depended on tankage exclusively for protein. Two kinds of fish meal were used, haddock, which is available in comparatively limited quantities, and menhaden. Both of these seemed equally good, and lowered the cost of gain from $1 to $2 per 100 pounds under the other rations used.

The Ohio experiment was the second in which a leading agricultural station recommended fish meal as being superior to other protein supplements for swine. Last February, the Iowa State College, concluding a year's tests, announced that best results could be obtained with hogs by using equal parts of fish meal and tankage in the ration instead of using only tankage for protein. * * *

The protein supplement thus derived by using both fish meal and tankage results in faster gains on less feed, lower feed cost, and greater profit, the Iowa authorities said. This announcement was followed by an almost sensational demand for fish meal in Iowa and near-by States, with a resultant falling off in the purchases of tankage. It was hailed by feed manufacturers and dealers as one of the most interesting of recent developments in feeding practices.

CATTLE

Fink (1896) reported the feeding of 3 pounds of fish meal per day per steer. The fish meal was mixed in the ration for 90 days. Favorable gains in weight were made.

Paterson (1920) in cattle-feeding experiments, testing the suitability of fish meal for fattening cattle, showed that the animals receiving the fish meal made the greatest gains in weight. The animals receiving decorticated peanut cake in the ration made average weekly gains of 14.7 pounds, whereas those on fish meal gained 15.1 pounds. In further feeding tests, lasting 110 days, the average weekly gains per head for the group receiving decorticated cotton cake amounted to 15.3 pounds and for the fish meal group 15.6 pounds. The carcasses of the animals fed on fish meal were inspected and showed no bad effects or tainting of the meat.

Hoard's Dairyman (1925) reported extracts from an address made by Prof. George W. Cavanaugh, of Cornell University, before the Certified Milk Producers Association, as follows:

There is no evidence whatever to show that the odor which usually is found with fish meal contaminates in the slightest degree either the milk or the eggs produced from cows or chickens which have had fish meal in their feed. Further, certified milk produced from a herd which has received fish meal in the ration has been distributed in three important cities in New York State, i. e., Syracuse, Rochester, and Buffalo, during the past year and a half or two years.

Certain effects on the animals receiving this ration are worthy of note. Ten one-year-old heifer calves were placed in a yard which contained a shed opened at one side. For a period of one year, in addition to the regular ration of hay and silage, they received a grain ration containing fish meal. These animals were measured and weighed each month during the year. At the end of the year they had an average height of 2½ inches in excess of the standard height and an average weight 300 pounds in excess of standard weight. One of the reasons why I think this increase in weight and height was obtained, is that the fish meal, which contains the finely ground bones of the fish, furnished the bone-making lime and phosphoric acid in exactly the right proportions.

The herd which some two years ago was placed upon this ration had previously been troubled by big neck, or goiter, in the young calves. Since the animals have been receiving this ration no case of goiter has been observed among the calves. The manager of the herd also reports that there has been no case of abortion during the same period, while previous to that time cases had occurred.

About the time that these observations were made the Bureau of Fisheries, United States Department of Commerce, published Document 967, entitled, "The Iodine Content of Seafood." In this document were published the results of analysis of most of our common foods, giving the amount of iodine present. Among the conclusions drawn from a study of these analyses one finds the following: "As a matter of comparison it has been shown that oysters, clams, and lobsters contain two hundred times as much iodine as milk, eggs, or beefsteak. Shrimp contains one hundred times as much, while crabs and most ocean fishes contain fifty times as much." The document further shows that milk contains 5 parts of iodine per billion, which is very small. Butter made from milk contains 105 parts per billion. Apparently the iodine of milk is contained in the milk fat.

An analysis of the fish meal was made to see whether it might not be supplying the elements in iodine which are necessary for the proper function of the thyroid gland. The result showed the fish meal to contain about 2,000 parts of iodine per billion. The dried matter of blue fish, cod, haddock, and mackerel contains about 1,500 parts of iodine per billion.

The fish meal is, therefore, relatively high in iodine and its use seems to have a beneficial effect not only on the health of the animals receiving it, but also on the vigor of their offspring. The milk produced by these animals was next examined to see whether its iodine content had been increased. Some milk was obtained from the herd which had been receiving this ration for over one and one-half years. This milk was found to contain from ten to fifteen times as much iodine as the amount stated in the Bureau of Fisheries Document 967, i. e., 50 to 75 parts of iodine per billion.

Doctor McClendon, of the University of Minnesota, has shown that there are four distinct zones in the United States with reference to high and low iodine content of water and, consequently, a low and high prevalence of goiter among the people. The first zone is the one in which there is less than one part of iodine per billion of water in that zone, notably around the Great Lakes, the number of goiter cases runs from 15 to 30 per thousand of population; whereas in the zones where the content runs from zero to one per thousand, the number of cases is in direct proportion to the amount of iodine.

I should like to say just one word on behalf of the iodine going in as food and without discouraging the use of iodine in drinking water or any other soluble form. If we stop to think, in that part of the country where the water has an extremely low iodine content, the soil itself must have a very low content because the water represents the drainage from the soil. If we have a water where the iodine content is high, we must not interpret the low number of goiter cases to the iodine which we get in the water alone, but add to that the iodine which you get in the food that is grown on a soil draining water from which has iodine.

While I have not the exact statistics to prove it, I am inclined to think that in the sections where the prevalence is small the major portion comes through the food and not through the drinking water and it was for that reason that I was trying to urge consideration of the value of iodine in a natural food product, rather than in intermittent doses of a soluble form.

This evidence is submitted to the Association of Certified Milk Producers for their consideration as one means of economically feeding cows to produce young stock of increased strength and health and to increase the resistance of the milk-producing animals to disease.

It is submitted also to the Association of Medical Milk Commissions as a possible means of contributing toward the solution of the goiter problem in those parts of the country, especially around the Great Lakes, where that trouble is prevalent.

POULTRY

According to Kaupp and Dearstyne (1926), growth studies with chicks showed that fish meal as a feed concentrate gave the lowest cost per pound of gain, followed by dried buttermilk, meat meal, and condensed milk in the order named.

The results of experiments at the New Hampshire station, (Stuart, 1928) indicated that 5 per cent of fish meal in the ration contains sufficient vitamin D to prevent rickets in chicks for at least 8 weeks. Fish meal, however, did not produce as much growth as the cod-liver oil or the cod-liver meal. Cod-liver oil and cod-liver meal were about equal in growth promotion. Two per cent of cod-liver oil was fed to one group, 2 per cent of cod-liver meal to the second group, and 5 per cent of fish meal to the third group. Otherwise, the rations were the same for each group and only water was allowed for drinking.

Titus, McNally, and Hilberg (1930), in growth studies with chicks, fed fish meals with good results. A specially prepared desiccated meat meal was used as a basis of comparison. This meat meal can not be obtained commercially and is not in any sense of the word a commercial product; therefore, any direct comparison between the marine products and this special meat meal, which is prepared from condemned carcasses, would be of no value to either the agricultural or the fishery industries.

The diets were the same except that 10 per cent North Atlantic white fish meal, 10 per cent menhaden fish meal, and 10 per cent shrimp meal were fed comparatively in the respective diets. The diets containing the two fish meals were about equal in efficiency and the diet containing the shrimp meal did not produce quite as good results as the fish meals. The authors stated that the protein of the menhaden fish meal was of better quality than that of the North Atlantic white fish meal, and the protein of the shrimp meal was poorer in quality than that of the menhaden fish meal.

George H. Conn (1930) said:

> Fish meal has been largely used in the past for feeding poultry, and it is quite likely that it will have its greatest use in the future for this purpose. It is now fed in quite large quantities to hogs, but hogs can be supplied with protein in a very satisfactory form in tankage or milk, or in many of the legumes that are grown on the average farm.
>
> Some recent statements have been made to the effect that while fish meal is very satisfactory in the ration for poultry it should not at any time constitute more than one-twentieth of the whole diet in the case of chickens, which means that it should not exceed more than one-twentieth of the total weight of mash and grain consumed by adult birds, and not more than one-tenth of the total feed of young growing birds. It is reported that the meal can be fed in slightly larger quantities to ducks than it can to chickens.
>
> For feeding poultry, fish meal will largely replace meat scraps or tankage. In the eastern part of the United States and particularly in the New England States large quantities are now being used for this purpose. Because it has a higher digestibility, especially as far as the protein content is concerned, and because it carries a somewhat higher content of bone, sulphate, and lime, it is slightly superior to tankage or meat scraps as a poultry feed.

FISH

Crawford and Nizam (1929) found that salmon meal was the best of the commercially prepared fish meals fed to fish and that herring meal was almost as good.

Davis and Lord (1930) reported that fish meals may be successfully incorporated in trout rations provided some fresh meat is included in the mixture.

FUR-BEARING ANIMALS

Feeding experiments indicate that marine products offer possibilities of profitable returns in the feeding of fur-bearing animals

The following is quoted from a report by W. J. Erskine on page 122 of Alaska Fisheries and Fur Industries in 1915 by Bower and Aller (1917). "The proper feeding of foxes is, of course, one of the most important matters to be considered in this business. We have tried many experiments along these lines, and are convinced that fish can safely be made the chief item of diet. * * * Canned salmon is used to quite an extent by a number of the fox ranchers, including ourselves." He further states that salmon heads are particularly relished by foxes, and that dried salmon backs make an excellent food.

EFFECT OF FISH-MEAL FEEDING ON MILK PRODUCTION

Very little study has been made of the effect of fish-meal feeding on either milk production or beef production. Certainly these subjects need to be investigated. There is every reason to believe, in the light of scientific data available, that fish meal should be a part of the dairy cow's ration. The heavy drain on the mineral reserve of the milk producer places the dairy cow in greater need of the quantity and diversity of minerals contained in fish meals than is the case of my other farm animal.

Ellington and Knott (1928) found that herring meal and soybean meal were about equal in value as to milk production and content of butterfat. "No disagreeable flavor could be noticed in the milk."

In feeding tests by the dairy division of the Bureau of Animal Industry of the United States Department of Agriculture, as reported by Weber (1916), dairy cows fed fish meal gave a greater yield of milk than those fed cottonseed meal. The meal had no detrimental effect on either the milk or the butter.

EFFECT OF FISH-MEAL FEEDING ON BUTTERFAT CONTENT OF MILK

According to Hansson (1926), amounts as large as 1 to 1.5 kilograms (2.2 to 3.3 pounds) of fish meal daily had no influence on the flavor of the milk produced by dairy cows, and this feed appeared to increase the butterfat content. The large percentage of mineral present was considerably in its favor, in addition to its high protein content. The analysis of the fish meal used was 65 per cent of crude protein, 2 to 2.5 per cent of fat and 16 to 17 per cent of inorganic matter.

Isaachsen and Ulvesli (1926) reported the feeding of herring meal to dairy cows with good results. Two kinds of herring meal were fed, one low in salt content and the other relatively high. Both meals gave satisfactory results, although the meal low in salt was the better of the two. Codfish meal was also fed to dairy cows with satisfactory results. However, the percentage of fat in the milk was not affected by fish meal.

EFFECT OF FISH-MEAL FEEDING ON EGG PRODUCTION

Straight (1923) found that in poultry feeding, fish meal proved to be a more economical feed for egg production than beef scrap. While the beef scrap produced more eggs, the cost of production per

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dozen of eggs was 14.4 cents, while on the fish meal ration the cost was only 14 cents. The egg production on the beef scrap ration was 1,777 and on the fish meal ration 1,615.

According to Blair (1923), two lots of 25 white leghorn pullets were selected for comparing beef scrap with fish scrap, each containing 60 per cent of protein, as protein supplements for egg production. The birds received equal amounts of scratch grain and mash. The lot receiving fish meal laid 1,816 eggs as compared with 1,755 eggs laid by the lot receiving beef scrap.

As reported by Kaupp (1925), fish meal and meat meal were found to be practically equal pound for pound on a protein basis as sources of protein for egg production in Rhode Island reds in a test of 12 months' duration. Kaupp and Dearstyne (1926) said that fish meal and meat meal were about equal for egg production; and, again, in 1927, Kaupp stated that the results were approximately equal, the figures favoring the meat meal slightly. Kaupp had previously said in 1924, in comparing these two products, that, in a repetition of experiments from the previous year, fish meal was again found to equal meat meal in poultry feeding.

Clayton (1927) made a study of various sources of proteins alone and in combination as egg producers. Seven pens of white leghorns were fed a standard commercial grain and mash to which was added various protein feeds. A three years' average production per bird was 114 eggs in a lot receiving beef scrap and cottonseed meal, 109 eggs when fed beef scrap, 99 eggs with shrimp meal, 79 eggs with cottonseed meal and 2 per cent ground lime, 120 eggs with beef scrap and 2 per cent of lime, 105 eggs with shrimp meal and 2 per cent of lime, and 93 eggs when no additional protein was fed.

In a study at the University of the Philippines (Fronda, 1929), five lots of 20 pullets each were fed for one year on a basal ration composed of 1 part of a grain mixture of corn and palay and 1 part of a mash mixture of rice bran, corn meal, and copra meal. Two of these lots had their basal ration supplemented with 5 and 10 per cent, respectively, of dried shrimp and two others with 5 and 10 per cent of fish meal.

The feed consumption was practically the same in all lots. When fed at the rate of 5 per cent both dried shrimp and fish meal were quite satisfactory and caused a profitable increase in egg production as compared with the check lot. Adding 10 per cent of these supplements further stimulated egg production, but not in proportion to the increased cost of the ration. The yearling hens which had received one or the other of these supplements during their pullet year were well grown and vigorous. The addition of the protein supplement to the basal ration lowered the mortality rate.

According to the periodical, "Farming in South Africa" (1929), the highest egg production was obtained by feeding 20 per cent of fish meal.

Shellfish meals have recently received considerable attention in poultry feeding, particularly for increasing egg production, both in this country and abroad. Consul Dunlap (1918) reported the following:

Difficulties in procuring sufficient quantities of nourishing food for barnyard fowl in Denmark have led to a number of experiments with poultry feed, one of which seems to have brought on the market a product that may hold its place even after normal conditions return. A meal made from the blue mussels that are found in countless numbers along the Danish coast has been tried and is now being offered on the market. It is claimed that this meal will increase egg production by more than 100 per cent. The food values and the keeping qualities of the meal are said to be satisfactory. It is delivered in sealed sacks of 25 or 50 kilos (55 or 110 pounds), costing 40 ore per kilo (about 10 cents per pound) delivered in Odense.

One great trouble with shellfish used as chicken feed has been that when the weather is warm the mussels quickly spoil and give forth a very disagreeable odor. It is now claimed, however, if blue mussels are dried at a very high temperature and afterwards ground to a comparatively fine meal, a hen feed is obtained which, if kept dry, is in no way objectionable and will last a long time. It has another special advantage in that it is not bulky and can, therefore, be delivered cheaply.

The meal in its dried form, according to an analysis made at an agricultural experiment station, contains the following elements: Lime (in the form of ashes), 71.41 per cent; sugar, starch, and other organic matter, 13.21 per cent; nitrogenous matter, 11.64 per cent; fats, 1.68 per cent; and water, 2.06 per cent. Thus it seems that the food contains an unusually large quantity of nitrogen, together with other nourishing elements, and a large amount of lime which is so necessary for forming the eggshell. It is claimed that this food mixed with grain gives ideal nourishment for hens, turkeys, ducks, and geese.

The experiment station that analyzed this meal also experimented with its use. Eight hens were fed for 12 days with barley bran and as much green vegetables as they would eat. The hens laid during that time 16 eggs, that is, 1⅓ eggs per day. The following nine days the hens were given the same ration with an addition of 25 grams of mussel meal per hen. During this time the hens laid 29 eggs, or 3⅜ eggs per day. These eggs weighed slightly more than those produced during the first nine days, so that is another point to be considered, eggs being sold here by weight, not by the dozen.

The following rations have been found satisfactory for feeding mussel meal to poultry: For each hen take 38½ grams of barley bran and the same quantity of the meal and mix into a soft mash; in addition use as much fresh vegetables or cooked potatoes as the hen will eat and 10 to 15 grams of whole grain in the evening. For ducks the ration should be 50 grams instead of 37½, and for geese or turkeys, 75 grams.

At first the poultry will not like the new food, but after a few days they will eat it willingly. There must not be too much set before them at one time and they must be allowed to have absolutely nothing else until they have eaten all that has been given them.

It has been estimated that the use of mussel meal for all the hens in Denmark, numbering about 6,000,000, would give an enormous increase in the total egg production of the country. The meal has been developed as a "war product" to supplement the 50 grams of feed per day that is allowed by the Government for each hen. It is thought, however, that even under normal conditions this new feed can be produced at a price to compete with imported feeds.

Manning (1929a) conducted poultry feeding experiments in which the value of crab meal as an egg producer was tested. The group receiving 20 per cent of crab meal in the ration produced almost twice as many eggs as was produced by the control pen.

In comparing crab meal and meat meal in egg production tests, as described by Manning (1929d), poultry receiving 20 per cent of crab meal in the ration produced 1,110 eggs, whereas those on a diet containing 20 per cent of meat meal produced only 855 eggs in the same period. The rations of both groups were otherwise the same.

EFFECT OF FISH-MEAL FEEDING ON THE QUALITY OF CARCASSES OF SWINE

Landis (1923) said that feeding fish meal improved slightly the quality of the carcasses of swine.

According to de Ruyter de Wildt (1925), slaughter records showed that pigs fed fish meal were more fleshy, better proportioned, and produced a better quality of meat. The flavor and odor after cooking were normal. Even though fish meal was fed up to the time of slaughtering no appreciable effect on the flavor or odor of the raw or cooked meat was evident.

In comparing the effect of fish meal and tankage on the rate of growth and on the texture and quality of the carcass of swine, Helyar (1926) reported the results to be about equal.

de Ruyter de Wildt (1928) made a favorable report on the effect of fish-meal feeding on the slaughter records of swine and carried the investigation even as far as the cured hams, finding no off-flavors or taste.

EFFECT OF FISH-MEAL FEEDING ON ODOR OF MILK, EGGS, AND MEAT

The following authorities reported that the feeding of fish meal had no deleterious effect on the odor of milk, eggs, or meat and that no fishy odor or taste was imparted thereby: Kuhn-Cornieten, 1894; Live Stock Journal, 1913; Weber, 1916; Crowther, 1916; Ashbrook, 1917; Paterson, 1920; Orr and Crichton, 1922; Scott, 1922; Hostetler, 1922; Patterson, 1925; de Ruyter de Wildt, 1925; Hansson, 1926; de Ruyter de Wildt, 1928; Farming in South Africa, 1929; Ellington and Knott, 1928; Lindsey, 1909; Woodward and others, 1924; Rowett Institute, 1922; Edwards, 1929; Wilgress, 1924; Ministry of Agriculture and Fisheries, 1919; Hoard's Dairyman, 1925.

In fact, Woodward and others (1924), in United States Department of Agriculture Bulletin No. 1272, said, "The flavor of the milk apparently was not impaired in any way either by exposing milk to the odor of fish meal or by feeding the cows 4 pounds of the fish meal one hour before milking."

Bartlett (1917) recommended feeding fish meal containing not over 2 to 4 per cent of oil and 3 per cent of salt. He suggested that a higher oil content in fish meal may cause a fishy taste in the meat products.

Green and Richardson (1924) reported that where pigs were fed fish meal as high as one-eighth of the total ration right up to the time of slaughtering, there was an unpleasant flavor observed in the bacon.

According to Orr, Crichton, and Green (1922), in several feeding experiments at the Rowett Institute, white fish meal made from fish cuttings, waste, etc., was fed to hogs, poultry, and dairy cattle without any fishy odor being noticeable in the pork, bacon, eggs, milk, or poultry meat. Poor quality fish meals, however, were found to taint the bacon in some cases unless the feeding of the fish meal was stopped four weeks prior to slaughtering.

EFFECT OF FISH MEALS HIGH IN SALT CONTENT ON FARM ANIMALS

Investigating the effect on swine of fish meal containing large amounts of salt, Rasenack (1925) found that a dose of 5.48 to 10 grams of salt per pig per day was not injurious. However, 75 to 100 grams daily caused death.

In feeding two kinds of herring meal to dairy cows, Isaachsen and Ulvesli found that the meal lower in salt content gave the better results of the two meals.

According to Wilgress (1924) importers of Hamburg, Germany, stated that "fish meal for feeding purposes should not contain more than 10 per cent of oil or 3 per cent of salt."

Haselhoff (1914) said that the salt content should not exceed 3 per cent.

PALATABILITY OF FISH MEAL

Archibald (1916) said that the palatability of fish meal is relatively good.

According to Templeton (1920) menhaden fish meal furnished by the United States Department of Agriculture proved to be a palatable feed and gave satisfactory gains.

Thompson (1919) reported the successful feeding of frozen fish to poultry during the winter in place of meat scrap; and the Live Stock Journal (1920) reported the successful feeding of fish meal to calves.

In feeding swine, Hicks (1922) stated that the fish meal fed was not relished and was therefore unsatisfactory.

Manning (1929d) found that poultry receiving crab meal in the ration had better appetites than those receiving meat meal.

DIGESTIBILITY OF FISH MEAL

Kaupp and Ivey (1922) reported the digestible nutrients of poultry feeds as determined by laboratory feeding tests. The coefficients of digestibility for poultry of fish meal were: Organic matter, 91.60 per cent: crude protein, 91.48 per cent; fat, 92.24 per cent. The average digestibility of these ingredients in fish meal ranked higher than that of any other feed or feed concentrate tested.

According to Isaachsen and Ulvesli (1926) the coefficients of digestibility for herring meal as determined with sheep were 88 per cent for protein, 95 per cent for fat, and 91 per cent for organic matter. Likewise, the coefficients of digestibility for codfish meal, determined in the same manner, were 90 per cent for protein and 95 per cent for fat.

Lindsey and Smith (1914) carried on 47 single digestion experiments with a variety of feedstuffs, using sheep as the experimental animals. The basal ration consisted of hay, corn, and gluten. Fish meal ranked relatively high in digestibility.

Orr, Crichton, and Green (1922) found that the pig can absorb over 90 per cent of the protein in fish meal. This fact was determined by carefully controlled metabolism experiments in which analyses of the feces were made.

AMOUNTS OF FISH MEAL COMMONLY FED IN THE RATION

Orr, Crichton, and Green (1922) recommended: "For a growing animal producing new tissue the proportion of protein to the other energy-yielding constituents of the ration (i. e., nutritive ratio) should be about 1 to 4 or 5 for young animals, and 1 to 6 or 7 for animals reaching maturity."

According to the Live Stock Journal (1913), cattle may be fed a daily allowance of from 2 to 2½ pounds of fish meal, and pigs about one-half pound.

Haselhoff (1914) suggested the following daily amounts of fish meal: Cattle, 2 pounds for every 1,000 pounds of live weight; pigs, from one-fourth to one-half pound per head, according to weight of swine; and sheep from one-tenth to one-fifth pound for every 100 pounds of live weight.

General instructions on balancing rations and on feeding practice have been issued by Borland and Loveland (1914).

Weber (1916) described the production of excellent results where fish meal was fed to pigs during the growing period at the rate of 0.5 pound per head per day and during the fattening period at the rate of 0.85 pound of fish meal per head per day. Satisfactory results were obtained when hens were fed on fish meal in the proportion of 20 per cent of the weight of the mash.

Manning (1929a) reported that egg production was practically doubled by substituting 20 per cent of crab meal in the poultry ration. The basal ration was low in protein.

Manning (1930) also reported that the live and dressed weights of pigs were more than doubled by substituting 10 per cent of fish meal in the ration. The basal ration was low in protein.

According to Leaflet No. 333 of the Ministry of Agriculture and Fisheries (1919), "Fish meal has been fed with satisfactory results to horses up to an amount of 2 pounds per head per day. Likewise, fish meal has been used with satisfactory results, to the extent of 2 or 3 pounds per head per day, by Scottish cattle feeders. Difficulty has been experienced in some cases in securing satisfactory consumption at the outset, but with a little ingenuity in blending the foods this is soon overcome. Experiments in Scandinavia and elsewhere have demonstrated that fish meal can be fed to dairy cows to the extent of 4 pounds or even more, per head daily, without imparting a fishy taint to the milk. In calf-rearing at the Kilmarnock farm, in 1916 and 1917, 1 part of fish meal to 2 parts of oatmeal were successfully used. Fish meal is a useful supplementary food for sheep on roots, and may be given at the rate of 2 to 3 ounces daily per 100 pounds live weight, in admixture with pulped roots or other food. It should be particularly useful for ewes in milk. Fish meal may be fed to pigs as high as 1 pound per head daily with excellent results. Fish meal should be introduced gradually into the diet of poultry, and the proportion used should not exceed one-twentieth of the whole diet in the case of chickens, or one-tenth in the case of adult fowls."

Wilgress (1924) reported that, in Germany, "from 1 to 5 ounces (of fish meal) per pig is given daily, varying according to the age of the pig."

PROTEINS IN FISH MEALS

Ingvaldsen (1929 and 1929a) has made two excellent contributions to our meager knowledge concerning the character of proteins in fish meals, including some data on the amino acids in these proteins. These two references are highly recommended to those interested in the chemical or technical phases of this subject.

Orr, Crichton, and Green (1922) emphasized the value of fish meal for its content of protein.

Edwards (1923) recommended fish meal as a supplement to corn to supply sufficient protein in hog rations.

Fish meal was used by Blair (1923) as a protein supplement in poultry rations, in egg production tests.

Kaupp (1925) found fish meal to be a good source of protein for poultry in egg production.

Ruffner and Curtis (1925) used fish meal as a protein supplement to corn for fattening pigs.

In testing protein supplements to corn in dry lot for fattening pigs, Godbey and Durant (1926) found fish meal to be superior to tankage.

Hansson (1926) commented favorably on the high protein content of fish meal in tests with dairy cows.

Davidson (1928), in studying rations for fattening pigs, mentioned the protein value of fish meal.

According to the Rowett Institute (1922), "Fish meal is an excellent source of protein for the growing pig."

Drummond (1918) found, in feeding tests with laboratory animals, that the coagulable proteins of the muscle tissue of cod, herring, and canned salmon possess a nutritive value as high as those derived from beef.

From unpublished data by McCollum and Daniel, in feeding experiments with rats at Johns Hopkins University, the excellent value of the proteins in fish meals was clearly demonstrated.

MINERALS IN FISH MEALS

Orr, Crichton, and Green (1922) emphasized the value of fish meal for its content of minerals. They stated that, "The results of experimental work at this institute (Rowett Research Institute) in connection with the mineral requirements of animals showed that the large amount of bone-forming material in fish meal makes it suitable for mixing with grains and certain other commonly used feeding stuffs which are deficient in this essential."

In dealing with the utilization of calcium and phosphorus, they said:

> Of the amounts of these two essential minerals given in the fish meal, more than a third was utilized by the animal and the amounts utilized were just about what the animal would be expected to require. * * *. A pig of 3 to 4 months old can absorb and retain as much as 5 grams of lime (CaO) per day. This mineral is required in the food to the extent of 1 to 2 per cent of the increase in weight, and growth is limited if the supply in the food is not sufficient. Grains are deficient in lime. Sharps contain only 0.08 per cent and maize (corn) less than 0.02 per cent. A pig putting on 2 pounds per day would require to eat over 20 pounds per day of a mixture of equal parts of these to get sufficient lime, whereas a quarter of a pound of fish meal would yield more than sufficient. It is not to be wondered at, therefore, that the addition of fish meal to a ration of grains and grain offal leads to increased gains in weight. The results of experiments carried out in connection with mineral requirement led us to believe that the undoubted beneficial effects of fish meal in growth were largely dependent on the minerals present. To test this, an experiment was carried out comparing fish meal with blood albumin (almost pure protein) to which mineral matter similar to that in fish meal had been added. It was found that the ration with blood albumin plus minerals gave

as good results as fish meal, but that with blood albumin alone, although for the first fortnight the gains were as good as with fish meal, afterwards growth slowed down and was no better than with a purely grain ration.

They further stated that " both milk and eggs consist very largely of protein and mineral matter. Three gallons of milk contain about 1 pound of protein, three-fourths of an ounce of lime (CaO) and an ounce of phosphorus (P_2O_5) so that a cow giving that amount of milk per day loses these quantities of essential substances that must be made good in the ration, unless it draws on its tissues and bones for them. Egg, like fish meal itself, consists almost entirely of protein, minerals, and fat. For milk cows and poultry, therefore, fish meal seems a most suitable food and it is not difficult to understand why good results are obtained in feeding it to these animals." Something to be remembered emphatically is a statement of the authors as follows: " With regard to meeting the requirements for mineral matter fish meal is so rich in this that if sufficient be given to yield the necessary amount of protein there is likely to be more than sufficient mineral matter present." They said that " in fish meal the ratio of calcium to phosphorus is about the same as is required for growth, and it might be expected that the percentage utilization would be high." This fact was subsequently proved by the authors in feeding experiments.

Edwards (1923) recommended fish meal along with corn to supply sufficient minerals in hog rations.

In feeding fish meal to dairy cows, Hansson (1926) said that the large percentage of minerals present in fish meal was considerably in its favor in addition to its high protein content.

In studying rations for fattening pigs, Davidson (1928) stated that fish meal was found to be valuable not only for its protein content but particularly for the amount and proportions of mineral constituents.

Robertson and Baskett (1929) reported that soybean meal was not as good as fish meal in poultry rations, unless the soybean meal was supplemented with minerals.

According to Jenny (1929), " Kelp, the aquatic crop, and the fish living in the sea have in them the mineral matter necessary to optimum nutrition—by feeding the milk cow certain proportions of kelp and ground dried fish (tuna fish minus the white meat) in her rations, we can supply the natural amounts of the essential minerals her feed lacks and at the same time provide animal proteins of the best quality to the ration." The author also said that the feeding of these marine products increased the iodine content of the milk many times its original centent.

Mann (1930) reported kelp, a dried seaweed, to be an excellent source of organic mineral salts for animal feeding. Feeding tests indicated that kelp was a better and cheaper source of minerals than an inorganic mixture of minerals. He states:

Feeding experiments indicate these are in the proper proportions to meet the requirements of the animal body. No great quantities seem to be needed, but a little seems to make a great deal of difference in the results from feeding. The best gains (with cattle) were made on a daily apportionment of 2½ ounces of the supplement (a commercial mixture of fish meal and kelp).

Insufficient iodine causes goiter, and this disease is largely corrected with the use of kelp in the feed. Fed to pregnant animals it will prevent the appearance of goiter in the offspring. Fed to dairy cattle it will increase the iodine content of milk so as to assure sufficient supplies of iodine to the consumers of that milk.

Manning (1929a and 1929d) attributed the excellent egg production records, resulting from feeding crab meal to poultry, to the quantity and variety of mineral constituents contained in the crab meal. The high percentages of calcium carbonate and calcium phosphate found in crab meal, and undoubtedly in a readily assimilable form, should be particularly beneficial in stimulating egg production and in producing a good shell texture. The relatively high content of iodine in crab meal should also stimulate egg production. Doctor Orr, whose excellent work has been mentioned so many times in this publication, has said that hens need lime and iodine for optimum egg production.

Hoard's Dairyman (1925) has quoted Doctor Cavanaugh as having said that he thought that the large gains in weight and height obtained by feeding 1-year-old heifer calves fish meal was due to the finely ground bones of the fish, which furnished "the bone-making lime and phosphoric acid in exactly right proportions."

In feeding fish meal to swine, Manning (1930) believed that the favorable results obtained were due, "not only to the high coefficient of digestibility of the protein contained in the fish meal, but due also to a certain amount of vitamin potency and a distribution of minerals in variety and proportion amply provided for by nature."

According to the Rowett Institute (1922) fish meal is an excellent source of mineral for the growing pig. In digestibility tests with a young pig, fish meal feeding increased the retention of lime (CaO) from 0 to 4.7 grams per day, and of phosphate (P_2O_5) from 3.4 to 8.4 grams. It was further stated that fish meal contained "good protein and well balanced mineral matter."

Orr and Husband (1922) said that "the ratio of lime to phosphorus in fish meal is not unlike that in sow's or cow's milk. The percentages, however, are so high that comparatively small amounts of this meal added to a ration yield a sufficient supply of these."

Haselhoff (1914) reported that calcium phosphate in fish meal is a valuable adjunct to the rations of farm animals.

To illustrate the importance of minerals in animal nutrition, Orr and Husband (1922) are quoted as follows:

> There is probably no subject in nutrition on which information is more needed than the mineral requirements of animals, and the best combination of foodstuffs to provide a ration with properly balanced minerals. Further knowledge would enable us to get more rapid gains in weight and a more economical use of feeding-stuffs, and would also probably throw light on many conditions of malnutrition whose causes are at present obscure.

VITAMINS IN FISH MEALS

Bohstedt (1923) reported that the results of a series of tests with rats have indicated that fish meal, tankage, and blood meal are deficient in both vitamins A and B, when fed as 1, 4, and 8 per cent respectively, of the ration.

According to Green and Richardson (1924), fish meal fed in comparison with corn meal to young pigs not only produced greater gains in weight on less feed consumed, but cured lameness in the control lot and prevented lameness in the fish meal lot.

Maynard and Miller (1927b), in calcification studies with menhaden fish meal, concluded that the better calcification of fish meal over oil meal of similar calcium and phosphorus ratio was due to vitamin D rather than the quality of the protein.

Miller and Maynard (1927) conducted calcification studies with rats fed menhaden oil and various menhaden fish meals. Rats receiving fish meal grew more rapidly than those in the check lot, and the ash content of the bones was about 15 per cent higher than that of the bones of the rats on the rachitic ration. The experiments indicated that both menhaden fish meal and menhaden oil contain the specific factor that aids in calcification.

Mussehl, Hill, and Ackerson (1928) said: "Cod-liver meal contains some vitamin D, but not as much as is associated with an equal amount of fat in cod-liver oil. Five per cent of cod-liver meal did not provide sufficient vitamin D to prevent rickets on a ration complete in all but the rickets-preventing factor." Poultry were used in the experiments.

In accordance with a report from Stuart (1928), the results of experiments indicated that 5 per cent of fish meal in the ration contains sufficient vitamin D to prevent rickets in chicks for at least eight weeks. Fish meal, however, did not produce as much growth as the cod-liver oil or cod-liver meal. Cod-liver oil and cod-liver meal were about equal in growth promotion. Two per cent of cod-liver oil was fed to one group, 2 per cent of cod-liver meal to the second group, and 5 per cent of fish meal to the third group. Otherwise, the rations were the same for each group and only water was allowed for drinking.

Bethke (1927) stated that cod-liver meal prevents leg weakness, that the meal varies in vitamin potency just as the oil does, that heat may attentuate its vitamin content, and that the source of the meal and its probable method of manufacture influence its antirachitic properties.

As reported by Cruikshank (1927) "a sample of cod-liver meal was tested for its potency in vitamins A and D, using white leghorn chicks as the experimental animals and for the basal ration a mixture of corn 97, calcium carbonate 2, and salt 1 part, with skim milk ad libitum. In the vitamin D experiments the corn was yellow and in the vitamin A experiments, white. Positive and negative controls were run in both series. It was found that 1 per cent of cod-liver meal was sufficient to protect the chicks against rickets and from 7 to 10 per cent to meet the requirements of vitamin A. Ophthalmia was not observed in the vitamin A deficiency, but respiratory and lung trouble, with nodular lesions of mouth and pharynx, and characteristic changes in the kidneys, in which the ureters and renal tubules were filled with an accumulation of urates, were observed."

E. M. Cruikshank, E. B. Hart, and J. G. Halpin report as follows on a poultry-feeding experiment, using cod-liver meal, cod-liver oil and ultra-violet light, in their vitamin studies:

Cod-liver meal containing 45 per cent of oil and 43 per cent of protein was tested for its vitamins A and D potency at the Wisconsin experiment station, using day-old chicks for the determination. In testing the vitamin D content 9 groups of chicks were fed for 6 weeks on a basal ration of 97 parts of yellow corn, 2 parts of calcium carbonate, 1 part of salt, and skimmed milk ad libitum. To the basal ration was added in the various groups ultra-violet light, cod-liver oil, and cod-liver meal in amounts varying from 1 to 10 per cent. In testing the vitamin A content 10 groups of chicks were fed a basal ration of 92 parts of white corn, 5 parts of yeast, 2 parts of calcium carbonate, 1 part of salt, and skim milk ad libitum. To the basal ration in the various groups were added ultra-violet light irradiation, cod-liver oil, and cod-liver meal in amounts varying from 1 to 10 per cent, and cod-liver meal and ultra-violet light in combination.

The chicks in the first phase of the experiment were killed for post-mortem examination. The tibia was dissected out and soaked in formalin and a longitudinal section from the proximal end treated with 1.5 per cent of silver nitrate and exposed to light. Ash analyses were also made of the bones. In the group receiving the basal ration the ash content of the tibia varied from 33 to 37 per cent, while in all other groups the ash content ranged from 46 to 52 per cent. The silver nitrate test showed good calcification in all groups save the check, where there was a wide uncalcified area of proliferating cartilage.

It was found that even 10 per cent of the cod-liver meal used in the experiment did not furnish sufficient vitamin A to protect against a deficiency in this respect, although chicks receiving this amount survived longer and did not show pathological symptoms in such a marked degree as those receiving less meal. It is concluded that the cod-liver meal used contains sufficient vitamin D to promote good calcification even when fed at a level of 1 per cent, but not enough vitamin A to protect birds from vitamin A deficiency even when fed at a 10 per cent level.

These results are verified by Hart, Steenbock, Kletzien, Scott, Halpin, and Johnson, in their poultry experiments at the Wisconsin Agricultural Experiment Station as shown herewith: "It has been demonstrated that cod-liver meal is an effective source of vitamin D but not of A. A ration containing 1 per cent of this product was sufficient to prevent leg weakness in chicks, but did not prevent the common symptoms of vitamin A deficiencies."

Unfortunately we possess far too meager a store of knowledge concerning the vitamin potency of fish meal and related marine products, except in the case of cod-liver oil where considerable scientific information is available as summarized by Manning (1929b). Needless to say, if a corresponding amount of scientific research had been expended on fish meal or other related marine products, suitable for the dietary of man and beast, as has been completed on cod-liver oil, our knowledge of the science of nutrition would be much advanced. It is only to be hoped that the future will provide such data.

COMPOSITION OF FISH MEALS

The composition of a fish meal is obviously of primary importance, as its composition determines its quality and its actual and relative feeding value. Fish meals vary considerably in composition, depending on the kind and freshness of the raw material from which they are manufactured, as well as the methods or processes of manufacture. Inasmuch as this subject was dealt with at length in the introduction to this manuscript, brief treatment will be given it here.

Under the general subject of the composition of fish meals are discussed: The manufacture of fish meals, the effect of storage on fish meals, analyses of fish meals, and adulteration of fish meals.

MANUFACTURE OF FISH MEALS

Inasmuch as this publication is designed primarily for the animal feeder and others in the agricultural and fishery industries interested in nutrition, no effort will be made herein to go into the details of the different methods and processes of manufacture. Enough has been said in the introduction to give a general idea of the common methods now in use for the preparation of fish meals. But, for the benefit of those readers who may wish to study this subject, the following references, listed in the bibliography, contain data on the production or manufacture of fish meals: Turrentine, 1915; Orr, Crichton, and Green, 1922; Dill, 1923; Ingvaldsen, 1929 and 1929a; Jewett, 1918; Dunlap, 1918 and 1920; United States Bureau of Fisheries, 1919 and 1930; Ministry of Agriculture and Fisheries, 1919; Wilgress, 1924; Bellwood, 1928; Conn, 1929a; Tressler, 1923; Le Clerc, 1928a; Manning, 1929; Vilbrandt and Abernethy, 1930; Greer, 1915.

EFFECT OF STORAGE ON FISH MEALS

Davies (1925 and 1926), in investigations on fish meals, has described at considerable length, the nature of the water-soluble nitrogen compounds and the changes occurring in the water-soluble nitrogen and in the amount of water-soluble phosphorus with different methods of treatment and storage.

Harrison, of the United States Bureau of Fisheries, has shown that fish meals, in storage, diminish in extractible fat, as indicated by a diminishing ether extract of the fish meals tested.[18]

ANALYSES OF FISH AND SHELLFISH MEALS

The following references, listed in the bibliography, contain analyses of various types of fish meals and shellfish meals: Werenskiold, 1898; Liechti, 1910; Schenke, 1903; Hals and Kavli, 1903; Darbishire and Goodwin, 1910; Bericht der Agrikultur Chemischen Kontroll Station, 1910; Kellner, Lehmann, and Konig, 1909; Curry and Smith, 1911; Haselhoff, 1910, 1911, 1912; Street, 1912; Smith and Beals, 1913; Kling, 1914; Hills et al., 1914; New York Agricultural Experiment Station, 1914; Journal of the Board of Agriculture, 1914; Smith and Beals, 1914; Jones et al., 1914; Curry and Smith, 1914; Street, Shepard, and Davis, 1914; Clark, 1915; Wessels, 1915; Smith, Beals, and Howard, 1915; Curry and Smith, 1915; Wilk, 1915; Wessels and Fitts, 1916; Curry and Smith, 1916; New York State Agricultural Experiment Station, 1916; Smith, 1916; Youngblood, 1916; Shutt, 1915; Jones et al., 1916; Cathcart, 1916; Wessels, 1917; New York State Agricultural Experiment Station, 1917; Smith, 1918; Cathcart, 1918; Shutt, 1919; New York State Agricultural Experiment Station, 1918; Bartlett, 1917; Jewett, 1918; Dunlap, 1918; United States Bureau of Fisheries, 1919; Min-

[18] Unpublished data in the files of the Bureau of Fisheries, by Roger W. Harrison.

istry of Agriculture and Fisheries, 1919; Tressler, 1923; Tressler and Wells, 1924; Wilgress, 1924; Wells, 1925; Hansson, 1926; Le Clerc, 1928a; Conn, 1929a; Manning, 1929, 1929a, 1929c, 1929d, 1930; Ingvaldsen, 1929, 1929a; Vilbrandt and Abernethy, 1930.

Kling (1914) commented on the variability of composition of the different brands of fish meal and recommended a uniform grade containing a guaranteed analysis of 50 per cent protein, 5 per cent fat, 5 per cent salt, and from 20 to 25 per cent calcium phosphate.

The analysis of the fish meal used by Hansson (1926) was: 65 per cent crude protein, 2 to 2.5 per cent fat, and 16 to 17 per cent inorganic matter. Satisfactory results were obtained by feeding this meal to dairy cows.

The following table is quoted from page 443 of Wells (1925):

Iodine content of fish meal

Kind of fish meal	As purchased		Dry basis	
	Mg. I per kilogram	Parts per billion	Mg. I per kilogram	Parts per billion
Menhaden	0.98	980	1.08	1,080
Salmon	1.28	1,280	1.31	1,310
Sardine	.89	890	.98	980
Shrimp	2.61	2,610	2.84	2,840

ADULTERATION OF FISH MEALS

Methods are described by Lucks (1915) for detecting meat meal adulteration of fish meal. It is not within the province of this report to elaborate on this phase of the subject. Those who are specially interested in adulteration of fish meals will find further information in this reference.

CONCLUSIONS

An effort has been made to assemble in readable form in one publication the American and foreign publications of researches and experiments conducted on the feeding of fish meals to various animals. For the convenience of the practical animal feeder this publication has been made as nontechnical as it was possible to do under the circumstances.

As scientific data and practical feeding tests have indicated, fish meals and related marine products have a nutritive value of considerable quality and diversity. As previously stated, marine products offer a most fertile field for nutritional investigations to the great benefit of man and his domestic animals.

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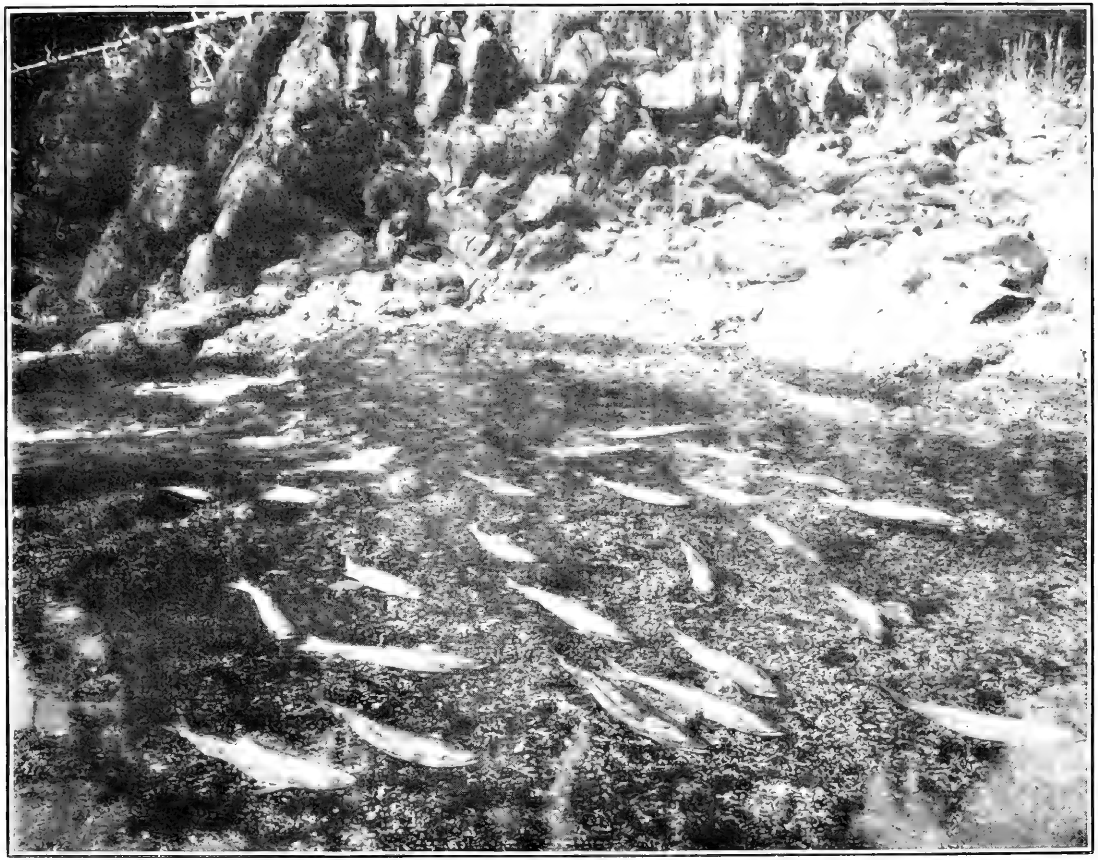

FIG. 1.—SALMON ON THE SPAWNING BEDS

PACIFIC SALMON FISHERIES [1]

By JOHN N. COBB
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CONTENTS

[1] Appendix XIII to the Report of the U. S. Commissioner of Fisheries for 1930. B. F. Doc. No. 1092. Submitted for publication Nov. 9, 1929.

INTRODUCTION

The most valuable commercial fisheries in the world, excepting only the oyster and herring fisheries, are those supported by the salmons. Of these the most important by far are the salmon fisheries of the Pacific coast of North America, where California, Oregon, Washington, and Alaska, including also British Columbia, possess industries representing millions of dollars of investment and millions of output annually. In Siberia the fishery is increasing in importance annually as means of transportation become better, while Japan is also becoming a large factor in the salmon markets of the world through her investments in the salmon fisheries of Siberia and, to a lesser extent, through fisheries prosecuted in her own waters.

In this fourth edition of the report [2] considerable new material has been added, while some chapters have been entirely remodeled and materially enlarged. The statistical data have been brought up to

[2] First edition: The Salmon Fisheries of the Pacific Coast. By John N. Cobb. U. S. Bureau of Fisheries Document No. 751, 180 pp. Washington, 1911.
Second edition: Pacific Salmon Fisheries. By John N. Cobb. U. S. Bureau of Fisheries Document No. 839, Appendix III, Report, U. S. Commissioner of Fisheries, 1916, 255 pp., 29 pls. Washington, 1917.
Third edition: Pacific Salmon Fisheries. By John N. Cobb. U. S. Bureau of Fisheries Document No. 902, Appendix I, Report, U. S. Commissioner of Fisheries, 1921, 268 pp., 48 figs. Washington, 1921.

January 1, 1929. The author is indebted to the Pacific Fisherman, of Seattle, Wash., for certain illustrations and to George C. Teal for permission to use his copyrighted picture shown as Figure 11. Most of the illustrations are from pictures taken by the author.

THE SPECIES OF SALMON AND THE RUNS

The Pacific coast salmons are all included in the genus *Oncorhynchus.* With them the fishermen incorrectly class the steelhead trout, which really belongs to the closely related genus *Salmo.*

As long ago as 1731 the species of *Oncorhynchus* were first made known by Steller, who, almost simultaneously with Krascheninikov, another early investigator, distinguished them with perfect accuracy under their Russian vernacular names. In 1792 Walbaum adopted these vernacular names in a scientific nomenclature for these fishes.

Five species of salmon (*Oncorhynchus*) are found in the waters of the north Pacific, ranging northward from Monterey Bay on the American Coast and Japan on the Asiatic, the extreme northern distribution of certain of the species having not yet been accurately determined. The five species are: (1) *Oncorhynchus tschawytscha,* quinnat, tyee, chinook, spring, or king salmon; (2) *Oncorhynchus nerka,* blueback, red, sukkegh, or sockeye salmon; (3) *Oncorhynchus kisutch,* silver, silverside, coho, or white salmon; (4) *Oncorhynchus keta,* chum or keta salmon; and (5) *Oncorhynchus gorbuscha,* humpback or pink salmon.

CHINOOK, QUINNAT, OR KING SALMON

The largest of the Pacific salmons is the chinook or king salmon (*O. tschawytscha*). It is found throughout the region from the Ventura River, Calif., to Norton Sound, Alaska, and on the Asiatic coast as far south as northern China. As knowledge extends, it will probably be recorded in the Arctic.

In the spring the body is silvery, the back, dorsal fin, and caudal fin having more or less of round black spots, and the sides of the head having a peculiar tin-colored metallic luster. In the fall the color is, in some places, black or dirty red. The fish has an average weight of about 22 pounds, but individuals weighing 70 to over 100 pounds are occasionally taken. One was caught near Klawak, Alaska, in 1909, which weighed 101 pounds without the head. The Yukon River is supposed to produce the finest examples, although this supposition is not based on very reliable observations. The southeast Alaska fish average as high as 23 pounds in certain seasons, followed by an average of about 22 pounds in the Columbia River and about 16 pounds in the Sacramento.

In most places the flesh is of a deep salmon red, but in certain places, notably southeast Alaska, Bristol Bay, Puget Sound, and British Columbia, many of the fish, the proportion being sometimes as much as one-third of the catch, have white flesh. A few examples have been taken with one side of the body red and the other white, while some are found with mottled flesh. No reasonable explanation of this phenomenon has yet been given.

In its southern range the quinnat strikes in at Monterey Bay in sufficient numbers to justify commercial fishing about the middle of April, where it is seen feeding upon the inshore moving schools of herring and sardines, continuing until in August. There are two runs of spawning fish in the Sacramento, the first or "spring run" beginning in April and continuing throughout May and June, these fish spawning mainly in the cold tributaries of the Sacramento, such as the McCloud and Fall Rivers. The second or "fall run" occurs in August, September, and October, and these fish spawn in the riffles in the main river between Tehama and Redding, also entering the tributaries in that vicinity. The two runs merge into each other. It is also claimed that there is a third run which comes in December.

In former years the San Joaquin and the American and Feather Rivers of the Sacramento system had large runs of salmon, but excessive fishing and the operation of various mining and irrigation projects have practically depleted them.

The Eel and Mad Rivers of northern California have only a late or fall run, while the Klamath River has both a spring and a fall run, and Smith River has a spring run alone. Rogue River in Oregon has both a spring and a fall run, and the Umpqua and several other coast streams of Oregon have small early runs.

The Columbia River has three runs, the first entering during January, February, and March, and spawning mainly in the Clackamas and neighboring streams. The second, which is the best run, enters during May, June, and part of July, spawning mainly in the headwaters. The third run occurs during late July, August, September, and part of October, and spawns in the tributaries of the lower Columbia.

In Puget Sound chinook salmon are found throughout the year, although it is only during the spawning season that they are very abundant. In the Fraser River, a tributary of the Sound, the run occurs from March to August.

In the Skeena River, British Columbia, the run occurs from May to July, the same being approximately true of the Naas also.

In southeast Alaska they are found all months of the year. From March to the middle of June they are abundant and feeding in the numerous straits and sounds; in May and June the spawning fish enter the Unuk, Stikine, Taku, Chilkat, Alsek, and Copper Rivers in large numbers, and in a few smaller streams in lesser abundance. In August, September, and October they are again to be found in large numbers feeding in the bays and sounds, while during the winter months a few have been taken on trawls set for halibut, showing that they are living in the lower depths at this time.

In Cook Inlet the run occurs during May and June and is composed wholly of red-meated fish; in the rivers of Bristol Bay the run comes in June and July, principally in the first-named month, and the same is true of the Togiak, Kuskokwim, and Yukon Rivers, the late appearance of the fish in the upper courses of the Yukon being due to the immense distance the fish have to cover.

SOCKEYE, BLUEBACK, OR RED SALMON

The red or sockeye salmon (*O. nerka*), when it first comes in from the sea is a clear bright blue above in color, silvery below. Soon after entering the river for the purpose of spawning the color of the head changes to a rich olive, the back and sides to crimson, and finally to a dark blood red, and the belly to a dirty white. The maximum weight is about 12 pounds, and length 3 feet, with the average weight about 5 pounds, varying greatly, however, in different localities. Observations of Chamberlain[3] in Alaska show that the average weight of a number of sockeyes taken from Yes Bay was 8.294 pounds, while the average weight of a number from Tamgas was only 3.934 pounds. Evermann and Goldsborough[4] report as a result of the weighings of 1,390 red salmon, taken from as many different places in Alaska as possible, an average weight for the males of 7.43 pounds; for the females, 5.78 pounds; or an average weight for both sexes of 6.57 pounds. A run of small, or dwarf, males accompanies certain of the main runs, being especially noticeable in the Chignik Lagoon (Alaska) run. This species usually enters streams with accessible lakes in their courses.

These fish are occasionally found landlocked in certain lakes, especially in the State of Washington, and are always much smaller in size than the sea-run fish. In Bumping Lake, near North Yakima, Wash., they are quite abundant and are mature when about a pound in weight. Despite the fact that these fish have a soft mouth, anglers consider them very gamey. They take bait, the fly, and the trolling spoon. Large numbers are hatched and distributed by the Washington Department of Fisheries under the name of "silver trout."

A few specimens of the sockeye have been taken as far south as the Sacramento River. In Humboldt County, Calif., small runs are said to occur in Mad and Eel Rivers, while 20 sockeyes are reported as having been taken in the Klamath River in the autumn of 1915. Only an occasional specimen appears in the coastal streams of Oregon. The Columbia is the most southern river in which this species is known to run in any considerable numbers, entering the river with the spring run of chinooks. From here south the species is called blueback exclusively. A considerable run enters the Quinault River, Wash., and there is also a small run in Ozette Lake, just south of Cape Flattery.

In the Puget Sound region, where it is known as the sockeye, this species ascends only the Skagit River in commercial numbers, although a small run appears in the Lake Washington system of lakes and, possibly, in the Snohomish, Stillaguamish, and Nooksack Rivers.

At one time the greatest of all the sockeye streams was the Fraser River, British Columbia, a stream famous from very early days for its enormous runs of this species, a peculiar feature of which is, that there is a marked quadrennial periodicity in the run. The maximum run occurs the year following leap year, the minimum on the year following that. The greater part of the catch of the Puget Sound fishermen is made from this run as it is passing through Washington waters on its way to the Fraser. The fish strike in during July and August on the southwest coast of Vancouver Island, apparently coming from the open sea to the northwest. They pass through the Straits of Juan de Fuca, Rosario, and Georgia, spending considerable time in the passage and about the mouth of the river. Small numbers run as early as May and as late as October, but the main body enters about the first week in August.

The sockeye occurs in most of the coastal streams of British Columbia, and is usually the most abundant species. The principal

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[3] Some Observations on Salmon and Trout in Alaska. By F. M. Chamberlain, naturalist, U. S. Fisheries steamer *Albatross*. U. S. Bureau of Fisheries Document No. 627, p. 80. Washington, 1907.

[4] The Fishes of Alaska. By B. W. Evermann and E. L. Goldsborough. Bulletin, U. S. Bureau of Fisheries, 1906, Vol. XXVI, p. 257. Washington, 1907.

streams frequented are the Skeena, Rivers Inlet, Naas, Lowe Inlet, Dean Channel, Namu Harbor, Bella Coola, Smith Inlet, Alert Bay, and Alberni Canal.

In Alaska, where this fish is generally known as the red salmon, it is abundant and runs in great numbers in all suitable streams, of which the following are the most important: In southeast Alaska, Boca de Quadra, Naha, Yes Bay, Thorne Bay, Karta Bay, Nowiskay, Peter Johnson, Hessa, Hetta, Hunter Bay, Klawak, Redfish Bay, Stikine, Taku, Chilkoot, Chilkat, Alsek, Situk, Ankow, etc.; in central Alaska, Copper, Knik, Kenai, Susitna, Afognak, Karluk, Alitak, Chignik; and in the Bristol Bay region, the Ugashik, Egegik, Naknek, Kvichak, Nushagak, and Wood. It is also supposed to occur in small numbers in the Togiak, Kuskokwim, and Yukon Rivers, which debouch into Bering Sea, and possibly occurs in the Arctic streams of Alaska. The run in western Alaska begins usually early in June and extends usually to the middle of August, the bulk of the run occurring in the first three weeks of July. It begins earlier in Prince William Sound, however, and sometimes extends into September in southeast Alaska. The duration of the run averages about the same in each section.

SILVER OR COHO SALMON

The silver or coho salmon (*O. kisutch*) is silvery in spring, greenish on the upper parts, where there are a few faint black spots. In the fall the males are mostly of a dirty red. The flesh in this species is of excellent flavor, but paler in color than the red salmon, and hence less valued for canning purposes. The maximum weight is about 30 pounds, with a general average of about 6 pounds.

The silver salmon is found as far south as Monterey Bay, where it appears during the month of July, and is taken by the trollers. From Eel River, in California, north, it is found in most of the coastal streams. It usually appears in July, and runs as late as November, the time of appearance and disappearance varying somewhat in different sections. Owing to its late appearance comparatively few, and they usually in the early part of the season, are packed by the canneries, most of which shut down in August and September. This fish also tarries but a short time about the mouth of the stream it is to enter, and is wary of nets, which makes it rather unprofitable to fish for the latter part of the season when it is running alone.

HUMPBACK OR PINK SALMON

The humpback or pink salmon (*O. gorbuscha*), the smallest of American species, weighs from 3 to 11 pounds, the average being about 4 pounds. Its color is bluish above, silvery below, the posterior and upper parts with many round black spots, the caudal fin always having a few large black spots oblong in shape. The males in fall are dirty red and are very much distorted in shape, a decided hump appearing on the back, from which deformity the species acquires its name. The flesh is pale, hence its canned name, "pink" salmon.

The southern limit of the fish is the San Lorenzo River, Santa Cruz County, but only occasional specimens are found here and in the rivers to the northward until Puget Sound is reached. Here a large run appears every other year, the only place on the coast where such is the case.

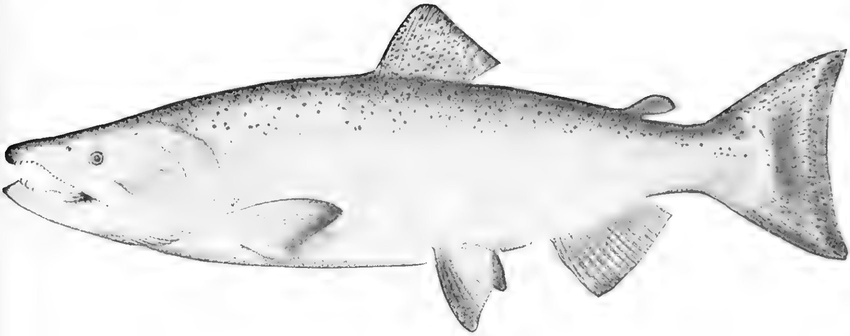

FIG. 2.—CHINOOK SALMON. BREEDING MALE

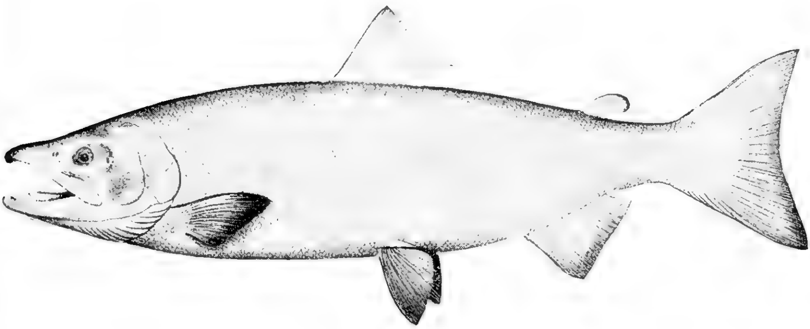

FIG. 3.—SOCKEYE SALMON. ADULT MALE

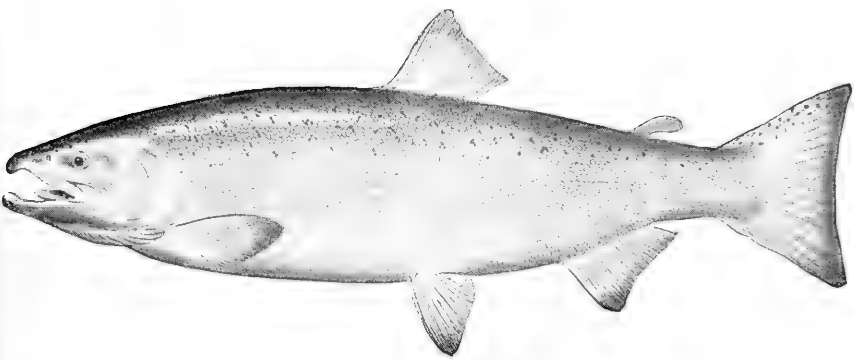

FIG. 4.—COHO SALMON. BREEDING MALE

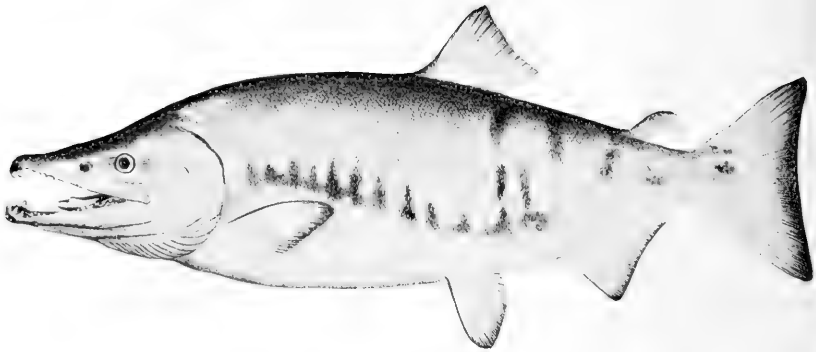

FIG. 5.—CHUM SALMON. BREEDING MALE

FIG. 6.—HUMPBACK SALMON. ADULT MALE

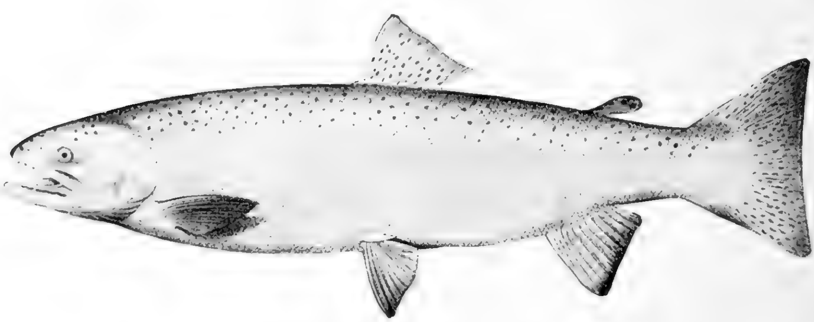

FIG. 7.—STEELHEAD TROUT

The humpback occurs in varying abundance in the waters of British Columbia, but it is in the waters of southeast Alaska that it appears in its greatest abundance. Many of the canneries in this region and some of those operating in central Alaska depend mainly upon the humpback for their season's pack, and the canned product now occupies an excellent position in the markets of the world. The fish spawn in nearly all of the small, short streams.

In western Alaska the runs are much smaller and the humpback is not much sought after by the cannery men, who are usually able to fill their cans with the more valuable species.

In southeast Alaska the run begins in June and continues until September. In western Alaska the period is somewhat shorter. In Puget Sound it continues until late in the fall, although but few are taken after September 15.

CHUM OR KETA SALMON

The chum or keta salmon (*O. keta*) reaches a maximum weight of 16 pounds, the average being about 8 pounds. When it first appears along the coast it is dirty silvery, immaculate or sprinkled with small black specks, the fins dusky, the sides with faint traces of gridironlike bars. Later in the season the male is brick red or blackish, and its jaws are greatly distorted. Its flesh is light yellow, especially when canned. It is especially good for freezing, salting, and smoking.

This species has a wide distribution. It is found as far south as San Lorenzo River, Santa Cruz County, Calif., but is not utilized commercially in California except on Eel River. It is found in most of the coastal streams from here north, being especially abundant from Puget Sound northward to southeast Alaska, both inclusive. In this region it is being utilized in greater abundance each year, as the market for it widens.

In central, western, and arctic Alaska the species occurs in varying abundance, but it is utilized sparingly, except by the natives, with whom it is the favorite species dried for winter food for their dogs.

The run of chum salmon comes later than that of any other species except the coho. In Alaska it begins in June, but the height of the season does not occur until late in August or early in September, and fish are found as late as November. In Puget Sound they run from about the middle of August till late in November, and practically the same is true in the Columbia River.

STEELHEAD TROUT

The steelhead trout (*Salmo gairdneri*) is commonly classed as one of the salmons by the fishermen of the Pacific coast, and it has been included in this report on this account. It is said to have received its common name from the hardness of the skull, several blows of the club being required to kill the salmon when taken into the boat. In different localities the average weight is placed at from 8 to 15 pounds, while extreme sizes reach 45 pounds. The excellent quality of its flesh causes it to be highly prized for the fresh and frozen markets, but owing to its pale color only limited quantities are canned.

The principal center of abundance of this species is the Columbia River. It is found from Carmel River, Calif., north to central Alaska, and possibly has an even wider range in Alaska. As a result of extensive plants made during the last 10 or 11 years the range has been much extended on the Pacific coast as well as elsewhere in this country. It seems to be found in the rivers during the greater part of the year. In the Columbia River the spawning season is from February to May, in Puget Sound in the spring, and in southeast Alaska in May and June. The best commercial fishing is in January, February, and March. In California the catching of this species is restricted to hook and line fishing.

AGE OF SALMON AT MATURITY

As practically all salmon which have the opportunity spawn but once and then die, knowledge of the age at which this occurs is of great interest both from an economic and scientific standpoint. Many attempts have been made to solve the problem with the sockeye and king salmon, the most important commercially of the five species, by means of marking artificially reared fry, usually by clipping one of their fins before they are liberated, as noted elsewhere in this report, but with unsatisfactory results.

Fortunately, certain experiments carried on in Tomales Bay, Calif., and in New Zealand, where king fry were planted in streams not frequented by the species in question and the return of the adults noted, have yielded some interesting and accurate information on the subject. These indicated that the age was four or more years, as no run was reported until the fourth year.

A more certain method of determining the age of salmon has been developed in recent years through the adaptation by American scientists of the discovery by European investigators that the ridges observed on the scales of certain fishes indicated a period of growth of the animal itself.

The late Dr. Charles H. Gilbert, of Stanford University, as early as 1910, applied this method to the determination of the age of the various species of Pacific salmon. As to its application to the Pacific salmon and the general method followed, Doctor Gilbert has the following to say:

While the method is new as regards Pacific salmon, it has been experimentally tested and fully approved by the Fisheries Board of Scotland in the case of the Atlantic salmon, and is now universally accepted as furnishing reliable data as to the age and many other facts in the life history of that fish. It has been shown to be applicable also to various species of trout, and its value has been demonstrated in fishes as widely divergent as the carp, the eel, the bass, the flounder, and the cod. Descriptions of this scale structure and its significance have appeared in a large number of papers, both scientific and popular. It will suffice here to repeat that the scale in general persists throughout life, and grows in proportion with the rest of the fish, principally by additions around its border. At intervals there is produced at the growing edge a delicate ridge upon the surface of the scale, the successive ridges thus formed being concentric and subcircular in contour, each representing the outline of the scale at a certain period in its development. Many of these ridges are formed in the course of a year's growth, the number varying so widely in different individuals and during successive years in the history of the same individual that number alone can not be depended on to determine age. For this purpose we rely upon the fact that the fish grows at widely different rates during different seasons of the year, spring-summer being a period of rapid growth and fall-winter a season when growth is greatly retarded or almost wholly arrested. During the period of rapid growth the ridges are widely separated, while during the slow growth of fall and winter the ridges are crowded closely together, forming a dense band. Thus it comes that the surface of the scale is mapped out in a definite succession of areas, a band of widely spaced rings always followed by a band of closely crowded rings, the two together constituting a single year's growth. That irregularities occur will not be denied, and this is natural, inasmuch as growth may be checked by other causes than the purely seasonal one. Also a considerable experience is requisite for the correct interpretation in many cases, and a small residue of doubtful significance has always remained. This element is too small to affect the general results, and further investigation will almost certainly eliminate the doubtful cases altogether.[5]

As a result of his investigations up to this point, Doctor Gilbert presented the following conclusions drawn from the data collected:

1. The sockeye spawns normally either in its fourth or fifth year, the king salmon in its fourth, fifth, sixth, or seventh year, the females of both species being preponderatingly 4-year fish.
2. The young of both sockeye and king salmon may migrate seaward shortly after hatching, or may reside in fresh water until their second spring. Those of the first type grow more rapidly than the second, but are subject to greater dangers and develop proportionately fewer adults.
3. Coho salmon spawn normally only in their third year. The young migrate either as fry or yearlings, but adults are developed almost exclusively from those which migrate as yearlings.
4. Dog [chum] salmon mature normally either in their third, fourth, or fifth years, the humpback always in their second year. The young of both species pass to sea as soon as they are free swimming.
5. The term "grilse," as used for Pacific salmon, signifies conspicuously undersized fish which sparingly accompany the spawning run. They are precociously developed in advance of the normal spawning period of the species. So far as known, the grilse of the king salmon, coho, and dog [chum] salmon are exclusively males; of the sockeye, almost exclusively males, except in the Columbia River, where both sexes are about equally represented. The larger grilse meet or overlap in size the smaller of those individuals which mature one year later at the normal period.
6. Grilse of the sockeye are in their third year, of the king salmon in their second or third year, of the coho and the dog [chum] salmon in their second year.
7. The great differences in size among individuals of a species observed in the spawning run are closely correlated with age, the younger fish averaging constantly smaller than those one year older, though the curves of the two may overlap.[6]

Since 1910 Doctor Gilbert devoted much of his time to investigations [7] along this line, especially on the sockeye, with most interesting and valuable results.

His observations on the sockeye runs of British Columbia indicate that they consist principally of four and five year fish and that these two classes appear during successive seasons in widely differing proportions; that each stream has its distinctive race of sockeye, the progeny returning at maturity to the parent stream; that sockeye fry rarely survive when they proceed to sea within the year in which they are hatched; and that sea feeding, with the consequent rapid growth, is the most important factor in producing early maturity, an equal number of years in fresh water producing comparatively little effect.

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[5] Age at Maturity of the Pacific Coast Salmon of the Genus Oncorhynchus. By Charles H. Gilbert. Bulletin, U. S. Bureau of Fisheries, 1912, Vol. XXXII, pp. 4, 5. Washington, 1913.

[6] Age at Maturity of the Pacific Coast Salmon of the Genus Oncorhynchus. By Charles H. Gilbert. Bulletin, U. S. Bureau of Fisheries, 1912, Vol. XXXII, pp. 21, 22. Washington, 1913.

[7] Contributions to the Life History of the Sockeye Salmon. (No. 1.) By C. H. Gilbert. Report of British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1913, with Appendices, pp. R53–78. Contributions to the Life History of the Sockeye Salmon. (No. 2.) By C. H. Gilbert. Report British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1914, with Appendices, pp. N45–75. Contributions to the Life History of the Sockeye Salmon. (No. 3.) By C. H. Gilbert. Report British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1915, with Appendices, pp. S27–64, 6 pls. Contributions to the Life History of the Sockeye Salmon. (No. 4.) By C. H. Gilbert. Report British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1917, with Appendices, pp. Q33–80, 14 pls. Contributions to the Life History of the Sockeye Salmon. (No. 5.) By C. H. Gilbert. Report British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1918, with Appendices, pp. X26–52, 24 pls. Contributions to the Life History of the Sockeye Salmon. (No. 6.) By C. H. Gilbert. Report, British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1919, with Appendices, pp. U35–68, 6 pls. Victoria, British Columbia.

Much along this line has been done by other biologists, in Canada, the United States, and Japan, and it is hoped that some day a full report on the natural history of the Pacific salmons may be prepared and published.

MARKING SALMON

A favorite recreation for quite a number of Pacific coast people has been the marking of salmon fry in order to find out the age at which they return to spawn, the rate of growth, etc. Scattered through the reports of the various State fish commissions, and occasionally in the reports of the United States Bureau of Fisheries, are to be found detailed reports of such markings and the sometimes remarkable results attained, apparently at varying periods subsequent to the marking.

All sorts of marks were employed. The favorite was the removal of the adipose fin, the experimenters appearing to be of the opinion that the fish would miss this the least of any. However, the entire or partial removal of nearly every fin was practiced by some one or other of the many experimenters. Sometimes a V or a U was punched out of the tail or the gill cover, and in one or two instances a tag was employed.

In time these marking experiments became so numerous, and so imperfect a record was kept of them by any central authority, that frequently it was impossible to tell, when an apparently marked specimen was obtained, where and when it was marked, and as a result but little dependence could have been placed upon them even had there been no other factors conspiring to vitiate their value.

Fishermen are continually finding in their nets salmon which they feel sure have been marked by some hatchery. Scores of times in the course of his various investigations of the fisheries of this coast the writer has been told of or shown specimens which the fishermen thought had been marked. Many of these marks were on the side of the fish and represented an M or W, depending upon the angle from which viewed, and it was impossible, generally, to convince the fishermen that this mark was caused by the twine of his gill net pressing on the side of the fish. The obvious fact that a fish could not survive when in the fry stage the infliction of such a mark did not occur to them.

Frequently the scars left by the suctorial organs of the lamprey have been mistakenly supposed to be hatchery marks. This scar resembles very closely a date stamp on a canceled letter.

One of the most interesting cases of salmon marking, and one which drives home the necessity for accepting reports of returns from such markings with extreme caution, is that of F. M. Chamberlain, then naturalist of the Bureau of Fisheries steamer *Albatross*, on the Naha Stream in Alaska.

In August, 1903, 1,600 red salmon fry, reared for the purpose from the 1902 eggs, at the Fortmann hatchery of the Alaska Packers Association, near Loring, Alaska, were marked by Mr. Chamberlain by excising both ventrals with fine curved scissors. The fry were released in the Naha River as soon as marked, at which time they were about three months old.

In 1906 between 50 and 100 adult reds with ventral fins missing were reported by the superintendent of the hatchery at Yes Bay, which is located on the northern side of Behm Canal (Naha being on the southern side) and some 15 miles farther up the canal than the mouth of Naha Stream. Some of these also had the adipose removed, this mark having also been used on some of the fry. At the Fortmann hatchery, where they were marked, only two of these fish were obtained in 1906.

From then on until 1912, a period of 9½ years, the return of a number of these supposedly marked fish is noted each year at the two hatcheries in question, the number reported in the latter year being larger than in some of the intervening years. In 1912 Mr. Chamberlain himself pointed out the impossibility of these all being from the fry he had marked and no further attention was paid to them.

The principal thing that this and some of the other many experiments in salmon marking prove is that the percentage of salmon which accidentally lose, either through disease or the attacks of their many enemies, one or more of their fins, or portions of same, is much larger than most people suppose. Out of the many millions taken annually in commercial and fish cultural operations it is not surprising that some should be minus such exposed portions of their anatomy, and this percentage would doubtless be found to be considerable were particular attention directed toward it. As it is now, it is only occasionally that the fisherman notices such loss, or mentions the same when he does, unless his attention has been directed to it by particular inquiry. In the Chamberlain experiment, for instance, after 1907 considerable publicity was given to the search for such marked fish, and the writer, in his travels through southeast Alaska during the succeeding years until the end of 1911, frequently was told by fishermen that they had caught salmon with missing fins. Inquiry developed that while a few of the lost fins were the same as Chamberlain had excised, a number were entirely different fins, showing that when the attention of fishermen was directed especially in this line many deformed fish would be found.

The confusion resulting from the many marking experiments carried on by different people shows the absolute necessity of some central authority regulating them if any real results are to be achieved from this line of endeavor. In 1908 the Secretary of Commerce, under authority of sections 11 and 12 of the Alaska fisheries law, directed that any persons desiring to mark and release salmon in Alaska first consult with and secure the written consent of the Commissioner of Fisheries or of the agent at the salmon fisheries of Alaska. It would be an excellent thing if some such control could also be exercised over these operations in the coastal States.

During the year 1916 Dr. Charles H. Gilbert, of Stanford University, assisted by Willis H. Rich, conducted salmon-marking experiments on an extensive scale. Late in the fall of 1915 a consignment of 100,000 eggs of the red salmon was forwarded to Seattle, Wash., from the station of the Bureau of Fisheries at Yes Bay, Alaska, of which 50,000 were reshipped to the Anderson Lake hatchery of the British Columbia Fisheries Department, located on the ocean side of Vancouver Island. The remaining 50,000 were sent to the Bureau of Fisheries hatchery at Quinault Lake, near the coast of Washington. The intention was as soon as the fry, hatched from these eggs, had developed into fingerlings to mark each lot with a distinctive marking and plant them in waters near the hatcheries, with the object of proving that the adult fish would return to the stream in which they had passed their early existence, no matter where the eggs were taken.

This plan could not be carried out at Anderson Lake, as the young fish resulting from the eggs, which were sent there, were not strong enough to survive the experiment. They were therefore liberated without marking. Those hatched at Quinault Lake were marked, however, and liberated in the summer of 1916. Doctor Gilbert has strong hopes that upon the return of the marked fish important data relating to the life history of the species will be obtained.

During February, March, and April, 1916, some 50,000 yearling sockeyes, which had been reared at the Bonneville hatchery of the Oregon Fish and Game Commission from eggs obtained from the Yes Bay (Alaska) hatchery of the United States Bureau of Fisheries, were marked by the removal of the adipose and both ventral fins, and the fish then liberated in Tanner Creek, a tributary of the Columbia. The fish were in an apparently healthy condition when liberated. In order to make sure that they suffered no ill effects from the marking a few were held until the wounds had healed perfectly, and these were not affected adversely.

During the summer of 1918 a number of marked fish were reported to have returned and been caught.

During the same period close watch was kept on the Quinault River for the return of marked sockeyes from that marking experiment but none were observed so far as known.

OCEAN HOME OF THE SALMON

All sorts of conjectures have been hazarded as to the ocean home of the salmon after the young fish have gone to sea and disappeared apparently from the ken of man. Many have conjured up visions of the vast schools of adult salmon surging along the coast hundreds of miles seeking for some suitable river in which to spawn, explaining in this wise the variations in the seasonal runs in different sections. Others think the fish go out into the greater depths of the ocean and there hide from man until the spawning instinct leads them back to the coast and thence to the stream in which they were born or planted.

Discoveries of recent years have quite altered this uncertainty, and we now are reasonably certain that the vast majority of the salmon are comparatively near our coast line, while others stay in the bays, straits, and sounds virtually all the time when not in the rivers.

Some years ago it was first noticed that king salmon would take the hook while in salt and brackish waters. At first only the anglers were interested in this fact, but as the demand for king salmon for mild curing became more insistent the commercial fishermen, attracted by the high prices paid, began to devote some attention to the fish during the early spring months, and soon trolling became a recognized branch of the industry. It was first taken up on a considerable scale in southeast Alaska in 1905.[8] As the demand for the fish increased, the fishermen extended operations until almost all of southeast Alaska waters were being fished. The length of the fishing season was also increased until now only the severe weather of winter prevents them from fishing. However, the halibut trawls occasionally come up during the season with king salmon on them, showing that they are still on the ground.

[8] Report on the Fisheries of Alaska. By John N. Cobb. Bureau of Fisheries Document No. 618, pp. 19–21. Washington, 1907.

The above is also true to a certain extent of the waters of British Columbia and Puget Sound and to a lesser extent, so far as has been disclosed, of Monterey Bay and the Oregon coast.

It has been known for some years that the silver, or coho, salmon would also take the hook under practically the same conditions as the king salmon, and the only reason this species has not been fished for to the same extent as the king has been because it was not large enough to be attractive to the mild curers, and hence there was a much lesser demand for it.

It had been supposed that the other species did not feed when in coastal waters, but Marsh and Cobb [9] state quite differently:

> Other species of salmon, in addition to the king, are found to take the trolling hook. For several weeks in July trollers in Union Bay, in southeast Alaska, caught a number of cohos and humpbacks while trolling for kings. The humpbacks were caught mainly with a spoon, no bait being used. Most of them appeared to have been feeding on needlefish and herring, according to the cutter who dressed them. A few red salmon are reported to have been caught on the trolling line by fishermen operating for king salmon in the neighborhood of Mary Island, near Dixon Entrance. Several fishermen report having in previous years frequently taken dog [chum] salmon on a hook in the bays along Chatham Strait.

In 1909 Mr. J. R. Heckman, of Ketchikan, Alaska, a well-known cannery man, told the writer that, while he was trying to install a floating trap near Cape Chacon, at the lower end of Prince of Wales Island, southeast Alaska, he on several occasions observed red salmon feeding on what he called a red shrimp.

This was also observed in 1912, when Doctor Gilbert reported, in connection with his observations of salmon fishing on Swiftsure Bank, off the Straits of San Juan de Fuca, that "during the past summer it was observed by Mr. J. P. Babcock and the writer that the sockeye on the Bank were feeding extensively on a small shrimp-like crustacean (*Thysanoessa spinifera*, Holmes), which floats in incredible numbers on the tides and forms a favorite food for the other species as well as for the sockeye." [10] He also found all the other species feeding voraciously in this neighborhood.

The experience of the fishermen operating in and off Port Moller, in Bering Sea, also affords confirmatory evidence along this line. A cannery was established on Port Moller in 1913, the avowed purpose of the owners being to catch what they claimed would be the enormous schools which annually resort to the great rivers of Bristol Bay, some 210 miles to the eastward from Port Moller. This cannery made a fairly large pack for a season or two, using purse seines in Bering Sea and traps along the shore. Misled by this, three other canneries were built in 1916 and 1917. In a season or two the catches of the combined plants had dropped to much less than the catch of the one cannery when operating alone, thus showing that the fishermen were operating on a run which was local to that neighborhood. This is borne out by the fact that the Bristol Bay runs showed no appreciable diminution when the catch was lowest at Port Moller. The pack of the Port Moller canneries for certain years was as follows:

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[9] The Fisheries of Alaska in 1909. By Millard C. Marsh and John N. Cobb. U. S. Bureau of Fisheries Document No. 730, p. 26. Washington, 1910.

[10] The Salmon on Swiftsure Bank. By Charles H. Gilbert. Report of British Columbia Commissioner of Fisheries for year ending Dec. 31, 1912, and Appendix, p. I 16. Victoria, British Columbia.

Pack of the Port Moller canneries

Year	Number of canneries	Cases packed	Year	Number of canneries	Cases packed
1913	1	44,150	1917	4	39,688
1914	1	87,175	1918	4	124,884
1915	1	105,674	1919	2	29,849
1916	2	132,367			

These observations would tend to confirm the belief which has been steadily growing in favor for some years that the salmon either spend the greater part of their life in the bays, straits, and sounds, or else in regions adjacent to the coast line.

The reason they had not been found in this region earlier is doubtless due to the fact that during the fall, winter, and spring months the weather on the north Pacific coast is such that fishing operations can not be carried on along the open coast, while in summer the fishermen are all busy on the spawning runs and have no time to devote to fish not yet arrived at maturity, which are probably feeding along the coast as usual.

FISHING GROUNDS AND HISTORY OF THE FISHERIES [11]

WASHINGTON

Puget Sound.—Strictly speaking, the name Puget Sound should be restricted to that long, narrow arm extending south from the Strait of Juan de Fuca, but a practice has developed, and is now common among fishermen and others, of designating all the great water area in the State of Washington, comprising Puget Sound proper, Strait of Juan de Fuca, Canal de Haro, Rosario Strait, the Gulf of Georgia, and the smaller straits, bays, and sounds, as Puget Sound, and this practice, for the sake of convenience, has been followed in this report.

This great indentation in the coast, with its numerous islands and many fine harbors, has greatly aided the development of this portion of Washington and has been specially favorable to the prosecution of the salmon and other fisheries. Numerous rivers and creeks enter the Sound, the more important of these being on the eastern shore and comprising the Nooksack, Skagit, Stillaguamish, Snohomish, Duwamish, Puyallup, and Nisqually. On the southern and western shores the tributary streams are nearly all small, the more important being the Skokomish, Quilcene, Dungeness, and Elwha.

As on other bodies of water on the Pacific coast frequented by salmon, the Indians were fishing for them when the first whites visited the country. The natives at this time, and for many years after, used reef nets and hooks and lines in the salt water, and spears, dip nets, and weirs in the rivers. Traders first reached the headwaters of the Fraser River and gradually worked down the same until they reached the sea.

For many years this region was comparatively isolated from the rest of the world, and the completion of transcontinental railroads has not completely changed this, owing to its distance from large

[11] For some of the regions the historical data are fragmentary and can not be considered as other than historical notes. It is hoped that some one will write a history of the industry before all of the pioneers have passed away.

consuming centers. As a result of this isolation, it was necessary for many years to resort to methods of preparation which would insure the preservation of the product for indefinite periods. Salting naturally came first, followed by canning, while the shipping of fresh salmon has been steadily growing in importance as transportation facilities increased.

The Northwest Co., a large fur-trading organization, about the beginning of last century first introduced the salting process and this was continued by the Hudson Bay Co. Both companies carried on the business primarily for the purpose of providing a winter stock for the use of their employees and for local sale. As shipping developed on the Pacific, a considerable export trade in salted salmon was developed with the Hawaiian Islands, Australia, China, and Japan, and with the eastern United States. Quinnat, or spring, and sockeye salmon were the principal species employed in the earlier years.

After the boundary line between Canada and the United States had been established in 1846, and what is now the State of Washington was acknowledged as part of the latter, a number of small traders and fish packers succeeded the Hudson Bay Co. In the early sixties several men were engaged in the business at Point Roberts, according to the Olympia Columbian of September 10, 1853. In 1873 V. T. Tull, of Olympia, established a salmon fishery at Mukilteo, principally for putting up fish in barrels. The first year 500 barrels were packed at Mukilteo, after which the fishery was moved temporarily to Seattle to take the late run up the Duwamish River, which is usually large. Fifteen hundred good large salmon have been taken at one haul of the seine in the Puyallup.

Bancroft's History of Washington, Idaho, and Montana contains among others the following references [12] to the early fishermen of the Sound:

> In 1874 Corbette & Macleay, of Portland, founded a fishery at Tacoma. Sixty barrels were packed in five days, only three men being employed.—New Tacoma Tribune, November 14, 1874. In 1876, John Bryggot, a Norwegian, founded another fishery at Salmon Bay, 6 miles north of Olympia. In 1878 a company of Puget Sound men established a fourth at Clallam Bay. They put up the first season 600 casks of salmon and 700 of halibut.—Morse's Wash. Terr., MS., xviii, 17–18. In the following season D. D. Hume established a fishery near Steilacoom for the purpose of salting salmon. In 1880 H. Levy, of Seattle, went to London with 100 barrels to introduce Puget Sound salted salmon to that market. In 1882 a salmon packing establishment was opened at Old Tacoma by —— Williams. Salmon ran in great numbers this year. One boat brought in a thousand fish.

The extension of the railroad to Puget Sound, thus furnishing an outlet to the rapidly growing population in the Middle West, did much to aid the industry. This also gave opportunity to begin the shipping of fresh halibut and salmon to eastern points. Ainsworth & Dunn, of Seattle, operating later under the name of the Seattle Fish Co., were the first successful pioneers in this branch of the industry, beginning about 1889, and carrying it on until they sold out in 1901, as noted later.

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[12] History of the Pacific States, Washington, Idaho, and Montana, 1845–1889, vol. 26, pp. 345–349. By Hubert Howe Bancroft.

In 1903 the San Juan Fishing & Packing Co., which had begun the fresh-fish business in 1899, bought this business from the Pacific Packing & Navigation Co., to which it had been sold in 1901.

The first salmon cannery on Puget Sound was erected by Jackson, Myers & Co., in 1877, at Mukilteo, in Snohomish County. The members of this firm had all been engaged previously in salmon canning on the Columbia River. The first pack was of 5,000 cases, composed wholly of silver, or coho, salmon. Later at this plant were put up the first humpbacks ever canned. In order to divert the minds of purchasers from the fact that the meat of the humpback was much lighter in color than the grades then known to the consuming public, the company printed on its label the legend, "Warranted not to turn red in the can." Even with this shrewd sizing up of the weak side of the consuming public the demand for humpback, or pink, salmon developed very slowly, and it was some years before it became a factor in the markets.

Within a year or two after the opening of the above plant another was started at Mukilteo by a man named Bigelow.

In 1880 the Myers's cannery was destroyed by a heavy fall of snow. It was rebuilt in West Seattle and was operated till 1888, when it was destroyed by fire. George T. Myers, now sole owner, built a new cannery at Milton, which was burned two years later, and he then came back to Seattle and built a cannery about where Ainsworth & Dunn's dock now stands. He remained here only one season, after which he moved to where the Pacific Coal Co.'s bunkers are now. Late in 1901 he sold out his plant to the United Fish Co., which company moved the plant to the foot of Connecticut Avenue, where they continued operations for two or three years and then quit.

The first Puget Sound sockeye cannery was built at Semiahmoo, near Blaine, by J. A. Martin and John Elwood about the year 1891. It was bought in 1892 for $500 by D. Drysdale, who shortly afterward rebuilt and greatly enlarged the plant. In the same year Mr. Drysdale demonstrated the commercial success of fish traps. Traps had been in operation before this, however. In 1893 Ainsworth & Dunn had a trap at Five Mile Rock, just beyond the lighthouse at Magnolia Bluff (now a part of Seattle), and there had been a trap or two in Elliott Bay even prior to this. Traps had not been profitable in this section, however, owing to the cheapness and abundance of salmon, haul seines being cheaper and more profitable to operate. A man named H. B. Kirby, who came originally from Nova Scotia, and another named Goodfellow put in the first trap for Mr. Drysdale.

During the early years of sockeye canning they were not sold to the trade as sockeyes, but as Alaska reds and Columbia River salmon, for which there had been an established market for some years.

H. Bell-Irving & Co., of Vancouver, British Columbia, were the pioneers in the labeling of the fish as sockeyes, this being in 1894–95. Like all virtually new products, sockeye salmon had a hard fight for several years to secure a foothold in the salmon markets, and it was not until the Spanish-American War in 1898 caused a heavy demand for canned foods that its position became finally established.

By 1900 a number of canneries had been erected on the shores of Puget Sound, most of which were then in active operation. In 1901 the Pacific Packing & Navigation Co. was organized under the laws of the State of New Jersey for the purpose of acquiring a number of salmon canneries on the coast. It was supposed to be backed by unlimited eastern capital, and its authorized capitalization was as follows: Common stock, $12,500,000; 7 per cent accumulative preferred stock, $12,500,000; and 6 per cent debentures, $7,000,000. It actually issued $6,037,000 common stock, $6,963,000 preferred stock, and $3,000,000 debentures. Subsequently the management effected an exchange of preferred stock for debentures, increasing the former to about $7,500,000 and decreasing the debentures to about $1,650,000.

The new company purchased a number of canneries in Alaska, also the following Puget Sound plants: Pacific American Fisheries Co.'s canneries at Fairhaven (now Bellingham) and Friday Harbor, the Ainsworth & Dunn canneries at Blaine and Seattle, and the Fairhaven Packing Co. cannery at Fairhaven.

The company had a very short career, ending up in the bankruptcy courts in 1903, and when all its affairs were wound up the stockholders received nothing, while the bondholders got but an exceedingly paltry sum out of all the money put into it.

Most of the canneries secured on Puget Sound were repurchased by their former owners or by new people.

In 1915 there were 41 canneries in operation. From this time on the industry fluctuated considerably. The blockade in the Fraser River in the big sockeye year of 1913, as noted elsewhere, caused a great falling off in the sockeye pack in subsequent "big years," with the result that there were 45 canneries in operation in 1917, 23 in 1921, 23 in 1925, and 14 in 1928.

Soleduck River.—This is a small stream, about 30 miles in length, which flows through the southwestern part of Clallam County and empties directly into the ocean. The Quillayute Indian Reservation is located here and the natives formerly caught salmon and marketed them on Puget Sound, but a small cannery, started at Mora, on this river, in 1912, furnished a market for the catch up to the end of 1915, when it was abandoned.

Hoh River.—This is a comparatively small river, which is wholly within Jefferson County, and debouches into the ocean in the northwestern part of the county. It passes through the Hoh Indian Reservation in its lower reaches. A cannery was built here in 1917 by Fletcher Bros. and has been operated most seasons since. In the spring of 1919 it was moved to a more convenient location about a mile from the original site.

Queets River.—This river, which is about 35 miles long, rises in the northern part of Jefferson County and empties directly into the ocean in the northwestern part of Grays Harbor County, within the bounds of the Quinault Indian Reservation. A small salmon cannery was built at Queets, in Jefferson County, in 1905, and has been operated nearly every season since.

Quinault River.—This river, which enters the ocean in the northwestern part of Grays Harbor County, has a length from the ocean to Quinault Lake of about 40 miles, wholly within the boundaries of the Quinault Indian Reservation.

This stream is especially noted for its long-continued annual run of Quinault salmon (*O. nerka*). These fish, which are noted for their especially red-colored flesh, make their appearance early in

December, when the Indians generally catch them for their own use, as they fear that if the whites got hold of the fish they might throw away the hearts. Should a heart be eaten at this time by a dog or chicken, the Indians believe the run would not come. In January, when the fish begin to be abundant, all danger of this seems to have passed, for the Indians then usually have a considerable number for sale, and these are generally shipped to distant markets in a fresh condition by the buyers. As soon as the canneries open at Moclips most of the fish are disposed of at that place. The run continues up to July 1. May and June are the best fishing months.

There is a fall run of chinooks in this river, which usually arrives in August and ends about October 15.

The silver salmon appear about October 1 and the run is generally over by November 15; the chum salmon appear about November 1, and the run is usually over by the middle of the same month, while the steelhead trout run between November 20 and May 1. None of the latter are canned.

Moclips, the terminus of the railroad, is about 10 miles from the river, and the fish are all taken by team to this place. Twenty fish, weighing approximately 100 pounds, are put in each box, and these are piled onto the wagons until a load has been accumulated. The team owners get 50 cents a box for hauling the loaded ones to Moclips and 5 cents a box for bringing the empty ones back.

In 1915 the records of the Indian agent show that the Indians fishing on the north side of the river caught 219,654 Quinault salmon, valued at $49,820, while those on the south side caught 135,353 of these fish, valued at $30,528.60, or a grand total of 355,007 fish, valued at $80,348.60. This does not take into account the results of the fishing for the other species of salmon and steelhead trout, which quite materially swell the total.

Fishing is restricted to the Indians, who also make their own fishery laws, with the advice and approval of the Office of Indian Affairs, as the State laws have no force inside the bounds of the reservation. Under the regulations now in force a clear channel of one-third the width must be left in the middle of the stream, which is from 250 to 300 yards in width. Each owner of a fishing location has to fish it in person; provided, however, that widows, orphans, minor children, old Indians, and those who are sick or have gainful occupations other than fishing are allowed to lease their locations or hire some one to fish them, and then only with the approval of the officer in charge.

During the Quinault season stake nets are used, while the rest of the time, as a result of the freshets, drift gill nets are used in the eddies. The stake nets are arranged in a rather peculiar manner. A line of stakes is run out for about one-third the width at right angles to the shore, and to these are attached a net by short ropes. From each stake a section of net is run out and downstream, curving inward like a hook at the end, the latter part being held in place by three stakes.

The stake nets are 40 to 60 meshes deep, with 5¼-inch stretch mesh, and are set 85 yards apart. A set of these as described above forms one fishing location.

The chinook gill nets are usually 8¾ to 9 inches stretch mesh and 24 meshes deep, while the gill nets for silvers, chums, and steelheads are of 7-inch stretch mesh and 35 meshes deep.

For some years the salmon from the Quinault River were brought to Hoquiam and Aberdeen for canning. In 1911 W. W. Kurtz, of the former place, began the erection of a cannery at Moclips for the purpose of packing these fish, and the same season his example was followed by Frank Shafer. Only one cannery was in operation in 1928.

Grays Harbor.—This is the first important indentation on the coast of Washington south of Cape Flattery. It is about 40 miles long from east to west and about 20 miles wide in the widest part. The principal tributary is the Chehalis River, but there are a number of small streams which debouch into the harbor.

In 1883 B. A. Seaborg, who operated a cannery on the Columbia River, established a plant at what was later to be the thriving city of Aberdeen, although at that time it was practically a wilderness.

In 1902 the North American Fisheries Co. built a plant at Aberdeen. Shortly after it came into the possession of the Grays Harbor Packing Co., and on June 8, 1903, it was destroyed by fire. It was rebuilt and operated by this company until 1906, when it was sold to S. Elmore & Co.

The Hoquiam Packing Co. built a cannery at Hoquiam in 1904 and operated it each season for a number of years.

In 1910, 2 canneries were in operation at Aberdeen and Hoquiam, respectively; in 1915 there were 3 at the former place and 1 at the latter; in 1919 there were 6 in operation; while in 1928 there were 4 in operation.

Willapa Harbor.—The entrance to this harbor, which also includes Shoalwater Bay, is about 27 miles south of Grays Harbor. The harbor runs east and west and is about 25 miles long. Shoalwater Bay extends south from it a distance of about 30 miles, its southern portion ending about a mile from the Columbia River and its western side being separated from the ocean by a spit varying in width from three-fourths to one mile. The bay is shallow, excepting in the main channel. The principal salmon streams entering the harbor are the Nasel and North Rivers, in which most of the pound or trap nets are located.

In 1884 B. A. Seaborg, a Columbia River canner, established a plant on Shoalwater Bay, as the whole of Willapa Harbor was then known.

About 1900 F. C. Barnes established a cannery at Sunshine, on the Nasel River, but the run of salmon on this river soon became so small that the plant was abandoned and the machinery moved to Mr. Barnes's cannery at South Bend.

In 1904 P. J. McGowan, the Columbia River canner, opened a cannery on the North River. Mr. McGowan, who was over 80 years of age at the time, had turned the control of his important Columbia River canning interest over to his sons, but finding idleness not to his liking, started this cannery in order to have something to occupy his time. He operated it for several years and then abandoned the project.

In 1912 the Chetlo Harbor Packing Co., established a cannery at Chetlo Harbor, but operated it only that year and in 1914.

In 1919 only 2 canneries, both of them at South Bend, operated on Willapa Harbor, while in 1928 there were 4 in operation.

COLUMBIA RIVER

The Columbia, which is the largest river of the Pacific coast, rises in British Columbia, flows through Washington, reaching the northern border of Oregon about 75 miles west of the State's eastern boundary; from this point the river forms the dividing line between Oregon and Washington, its general course being westerly. It empties into the Pacific at Cape Disappointment. Its principal tributaries are the Spokane, Yakima, Snake, John Day, Deschutes, and Willamette Rivers, and through these the main river drains an enormous extent of territory.

This river, which has produced more salmon than any other river in the world, has had a most interesting history. Many years before the white man saw its waters the Indians visited its banks during the annual salmon runs and caught and cured their winter's supply of food. Along the shores of the river at The Dalles for 15 miles were notable fisheries where various bands, who lived south and north, had their respective fishing locations, and to which all others were forbidden access. They used spears and dip nets in catching the salmon, the majority of which were dried and smoked for winter use. This dip, or basket, net was fastened to a pole about 30 feet long and slid on a hoop. The Indian filled it by slinging it as far as possible up the stream and then hauling it up, the weight of the fish closing the net by drawing it on the hoop.

A favorite preparation of the Indians who resorted to the river was pemmican. This was the meat of the salmon cleaned of the bones, pounded up fine, and then packed in hempen sacks of home manufacture. A sack of pemmican weighed from 80 to 90 pounds and was worth in barter as much as an ordinary horse.

Captain Wilkes, United States Navy, has the following to say with respect to salmon fishing by natives at Kettle Falls on the Columbia River near the present city of Colville, Wash., at the time of his visit there in 1841:

> There is an Indian village on the banks of the great falls, inhabited by a few families, who are called "Quiarlpi" (basket people), from the circumstance of their using baskets to catch their fish (salmon). The season for the salmon fishery had not yet (in June ?) arrived, so that our gentlemen did not see the manner of taking the fish; but, as described to them, the fishing apparatus consists of a large wicker basket supported by long poles inserted into it and fixed in the rocks. The lower part, which is of the basket form, is joined to a broad frame spreading above, against which the fish in attempting to jump the falls strike and are thrown back into the basket. This basket during the fishing season is raised three times in the day (24 hours), and at each haul not unfrequently contains 300 fine fish. A division of these takes place at sunset each day under the direction of one of the chief men of the village, and to each family is allotted the number it may be entitled to; not only the resident Indians, but all who may be there fishing, or by accident, are equally included in the distribution.[13]

The first American to engage in fishing on the Columbia River was Capt. Nathaniel J. Wyeth, of Massachusetts, who in 1832 crossed overland to Oregon with the purpose of establishing salmon fisheries in connection with prosecuting the Indian and fur trade. He dispatched a vessel via Cape Horn to the Columbia with trading goods, but she was never heard from after sailing. In the meantime Wyeth had established a station at Fort Hall, on the Lewis River, a branch of the Columbia.

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[13] Narrative of the United States Exploring Expedition during the Years 1838, 1839, 1840, 1841, and 1842. By Charles Wilkes, U. S. Navy, commander of the expedition. In 5 volumes. Vol. IV, pp. 444, 445. Philadelphia, Lee & Blanchard, 1845.

In 1833 Captain Wyeth returned overland to Boston, while the rest of his party dispersed throughout the Columbia Valley. Far from disheartened by the disaster to his vessel, Captain Wyeth dispatched the brig *May Dacre*, Captain Lambert, laden with trading goods and supplies, to the Columbia River via Cape Horn, while he crossed overland with 200 men. He established a salmon fishery and fort at the lower end of Wappatoo (now Sauvies) Island, at the mouth of the Willamette River.

The salmon fishery did not prove successful and the brig sailed in 1835 with only a half cargo of fish and did not come back. The same year Captain Wyeth broke up both the establishment here and on the Lewis River and, disheartened, returned to Massachusetts, having found the competition of the Hudson Bay Co. too powerful for him.

In August, 1840, Capt. John H. Couch, in command of the brig *Maryland*, which belonged to Cushing & Co., of Newburyport, Mass., arrived in the Columbia River. After taking a few salmon the vessel left in the autumn, never to return. On April 2, 1842, Captain Couch reappeared in the river with a new vessel, the *Chenamus*, named after the chief of the Chinooks. With his cargo of goods he established himself at the present site of Oregon City, the first American trading house to be established in the Willamette Valley. He also established a small fishery on the Columbia River. The vessel returned to Newburyport in the autumn.

The next American vessel to come in established a far from enviable record. There is no record of her name, but she was commanded by a man named Chapman and entered the river April 10, 1842. She came for the purpose of trading and fishing and remained till autumn. During her presence in the river it is charged she sold liquor to the Clatsop and other savages, as a result of which much bloodshed and discord resulted.

About 1857 John West began salting salmon in barrels at Westport, on the lower Columbia.

In February, 1859, the Washington Legislature passed an act prohibiting nonresidents from taking fish on the beach of the Columbia between Point Ellis and Cape Hancock.

Bancroft [14] states:

> On the 26th of January, 1861, J. T. Lovelace and W. H. Dillon were granted the exclusive right to fish in the Columbia for a distance of 1 mile along its banks and extending from low-water mark half a mile toward the middle of the stream.

In 1861 H. N. Rice and Jotham Reed began packing salted salmon in barrels at Oak Point, 60 miles below Portland. The first season's pack amounted to 600 barrels. The venture proved fairly profitable and was soon participated in by others.

In the spring of 1866 William Hume, who had assisted in starting the first salmon cannery in the United States on the Sacramento River in 1864, finding the run of fish in the latter stream rather disappointing, started a cannery for Hapgood, Hume & Co. on the Columbia at Eagle Cliff, Wash., about 40 miles above Astoria.

The year this first cannery operated the following fishermen were operating in the river: Jotham Reed used a trap and a small gill net opposite Oak Point; Mr. Wallace fished a small seine from the shore of an island of that name a short distance below; John T. M. Harrington (who was later to establish the Pillar Rock cannery), in

[14] History of the Pacific States, Washington, Idaho, and Montana, 1845–1889, vol. 26, p. 349. By Hubert Howe Bancroft.

conjunction with a man named Fitzpatrick, operated a seine at Tenasillihe, as did also a Mr. Welch; P. J. McGowan, who, with his sons, in 1884 started a cannery at McGowan, and later, at Warrendale, Ilwaco, etc., operated two small seines at Chinook Beach; and Hapgood, Hume & Co. had two small gill nets about 125 fathoms in length and 32 meshes deep. The gill net of Mr. Reed was much smaller than these. At this period the river literally swarmed with salmon, and the cannery had no trouble in packing 4,000 cases, which it increased to 18,000 the next year and to 28,000 cases in 1868.

In 1867 a crude cannery on a scow was started by S. W. Aldrich, a ship carpenter. The scow was about 50 by 20 feet, with a cabin on it, and in one end of this he constructed a brick furnace in which he set a large cast-iron cauldron for a cooker. Along one side he rigged a bench and manufactured the cans. Aldrich was a regular jack-of-all-trades, as he did everything from catching the fish to canning and cooking them ready for the market.

In 1868 a cannery was built near Eagle Cliff by one of the Humes, while in 1873 R. D. Hume built another at Bay View, Wash. He operated it until 1876, when Mr. Leveridge, of Leveridge, Wadhams & Co., of San Francisco, bought it and operated it during 1877 and 1878. George W. Hume took it then and a few years later sold it to David Morgan, jr., who got into financial difficulties, and the plant was ordered sold by the court. C. W. Fulton, of Astoria, later a United States Senator, had the matter in charge, but was unable to find a customer, and finally in desperation offered it to W. H. Barker, of George & Barker, for $600. Mr. Fulton closed with him the same day. It proved a most profitable transaction for the purchasers, who acquired a million and a half labels which could be utilized, the machinery was taken out for other plants, the timber on the land belonging to the tract sold, and the floating property sold for a considerable sum, after which the stripped plant and land were sold back to Mr. Morgan for $600, the purchase price. He sold it to George W. Hume, who wanted it to correct a title. It was sold for taxes a couple of years later and was bought in by B. A. Seaborg, who operated it for two years, since when it has been idle.

George W. Hume was the first salmon canner to employ Chinese. This was at Eagle Cliff in 1872. At this period the white laborers in the canneries were recruited from the riffraff and criminal element of Portland. He had a Chinese working for him and through this man secured a Chinese gang from Portland. This labor proved so satisfactory that the custom soon spread to the other canneries. It was not found that the Chinese could do the work any better or quicker than the white laborer, but they proved more reliable in their work and gave less trouble.

Donald and Kenneth Macleay, of Portland, and William Corbitt, of San Francisco, who were in business in Portland, were the first to make a direct shipment of canned salmon to Liverpool. This was in 1871, and the shipment abroad that year amounted to 30,000 cases.

Of the 35 canneries on the Columbia River in 1881, it is said that about one-half had been established by the Hume brothers. G. W. and William Hume were partners in the firm of Hapgood, Hume & Co., on the Sacramento River, and established the first cannery on the Columbia. In 1881 William was the proprietor of two canneries, one at Astoria, Oreg., and one at Eagle Cliff, Wash. R. D. Hume, a third brother, in the same year had a cannery in operation on the Rogue River, and established three others, one at Eagle Cliff (then owned by William Hume), one at Rainier (then belonging to Jackson & Myers), and one at Astoria. The fourth brother, Joseph, came to the coast in 1871 and some time later established a cannery on the river.

One of the pioneer canners on the river was the late F. M. Warren, operating as the Warren Packing Co., who established a cannery at Cathlamet, Wash., in 1869. The same company is still operating the plant. Later another cannery was established at Warrendale, Oreg., and it also is still operated by this company. Mr. Warren was the inventor of a retort, patented on April 10, 1877, which was in use by the principal canneries on the coast for a number of years.

John West was another pioneer. He built a cannery at Hungry Harbor, Wash., about 1869. In 1881 he moved his plant to Westport, on the Oregon side of the river. Mr. West was the inventor of a packing machine for placing the fish in the cans.

In 1871 the firm of Megler & Jewett established a cannery on the present site of Brookfield, Wash., and named it in honor of Mrs. Megler's birthplace, North Brookfield, Mass. In 1876 the plant was greatly enlarged and J. G. Megler bought out his partners and took in Mr. Macleay, of Corbitt-Macleay, wholesale grocers, of Portland and San Francisco, and changed the firm name to J. G. Megler & Co., under which title it operated until 1929. In 1879 Mr. Megler bought out this partner and owned the plant until his death in 1915, since when it was operated by his widow for a number of years and then was leased.

The first soldering machine used on the Columbia River was in this plant, while the steam box and lacquering machines were first put in use on the river in this plant.

In 1874 the Adair brothers, S. D. and John, jr., erected a cannery at Astoria, the second one to be built there. Before packing began, A. Booth, the well-known Chicago fish dealer, and progenitor of the present Booth Fisheries Co., acquired a half interest in the plant, which was then named A. Booth & Co. John Adair, jr., was the manager. The brothers established canneries on the Fraser River and in some seasons exchanged places in operating on the two rivers. S. D. Adair sold out his cannery on the Fraser and bought one on the Columbia and operated it under the firm name of S. D. Adair & Co. After selling out his interest in A. Booth & Co., S. D. Adair formed a partnership with William B. Adair under the style of S. D. Adair & Co. in 1881. The brothers were active in the industry for a number of years.

J. O. Hanthorn, under the firm name of J. O. Hanthorn & Co., established one of the largest canneries on the river at Astoria in 1876. He invented a rotary can washer for washing cans after they were filled ready for soldering and before the tops were put on.

In the same year Marshall J. Kinney began his long and interesting career in the canning business by establishing a cannery at Astoria.

One of the most noted men the Columbia River produced was Mathias Jensen, a Dane, who fished there for some years. He achieved especial fame from his important inventions in canning machinery. His first invention, however, was a machine for filling needles for knitting salmon nets. He next invented a can-filling machine, which is in common use to-day. He also invented the first topping machine, which was a marked success. The patent rights of both these machines were sold to the Alaska Packers Association. The machines were all made at the plant of the Astoria Iron Works, at Astoria, of which Mr. John Fox was the founder.

The first fish trap or pound on the river was constructed by Mr. Graham, in Baker Bay, on the Washington shore, in 1879. In1881 Mr. P. J. McGowan built some traps just below the bay. The traps were very successful at times.

The first purse seine on the river was operated by William Graham & Co. in 1906.

Below appears a list of the canneries operated on the Columbia River in 1881, together with the pack of each during the year in question:

J. Williams (Oregon side)	9, 000
Astoria Packing Co	30, 000
Elmore Packing Co	7, 890
Astoria Fishery (M. J. Kinney)	26, 000
Wm. Hume	20, 000
Geo. W. Hume	18, 000
Devlin & Co	20, 000
Occident Packing Co	15, 000
West Coast	15, 000
Badollet & Co	25, 000
Booth & Co	23, 000
Eagle Cannery	17, 300
Timmins & Co	8, 000
Fishermen's Packing Co	19, 000
S. D. Adair & Co	10, 000
Anglo-American Packing Co	10, 300
Hanthorn & Co	19, 000
Scandinavian Co	20, 000
J. W. & V. Cook	30, 000
F. M. Warren	12, 000
J. West	12, 000
Jackson & Myers (2 canneries)	13, 000
Aberdeen Packing Co. (Washington Territory side)	17, 000
Jos. Hume, Knappton	20, 225
Pillar Rock Co	15, 000
J. G. Megler & Co	25, 000
Columbia Canning Co	8, 000
R. D. Hume & Co	8, 300
Cathlamet Cannery	8, 000
Jas. Quinn	5, 000
Cutting & Co	20, 000
Eureka Packing Co	20, 000
Hapgood & Co	13, 000
Eagle Cliff Cannery	10, 000
Total	549, 115

An interesting compilation prepared by the Portland Board of Trade [15] shows the total product in cases, the price per case of 48 pounds, and the price for each fish paid by the canneries to the fishermen from 1866 to 1881:

Year	Total product	Price	Cost of fish	Year	Total product	Price	Cost of fish
			Cents				*Cents*
1866	4, 000	$16. 00	15	1874	350, 000	$6. 50	25
1867	18, 000	13. 00	15	1875	375, 000	5. 60	25
1868	28, 000	12. 00	20	1876	450, 000	4. 50	25
1869	100, 000	10. 00	20	1877	460, 000	5. 20	25
1870	150, 000	9. 00	20	1878	460, 000	5. 00	25
1871	200, 000	9. 50	22½	1879	480, 000	4. 60	50
1872	250, 000	8. 00	25	1880	530, 000	4. 80	50
1873	250, 000	7. 00	25	1881	550, 000	5. 00	60

The banner year in the canning industry was 1884, when 620,000 cases of chinook salmon were marketed. At this time the runs were so enormous that tons and tons of salmon were thrown overboard by the fishermen because the canneries were unable to handle them.

As in other sections, there came a time when the market began to be glutted by the packs of the numerous canneries, and it was found

[15] The Commerce and Industries of the Pacific Coast of North America, pp. 372, 373. By John S. Hittell. San Francisco, 1882.

necessary to combine some of the plants in order to operate more cheaply and also to reduce the output.

In 1885 W. H. Barker and George H. George, who had been connected with various canneries, formed a partnership as George & Barker and purchased the Astoria cannery of the Port Adams Packing Co., then 2 years old.

Shortly before this a combination which was named the Eureka & Epicure Packing Co. had been formed and comprised the following plants: Knappton Packing Co., Knappton; North Shore Packing Co., just below Knappton; and the Eureka Packing Co. This combination got into financial difficulties, and the reorganizers persuaded George & Barker to join the combination and take charge.

In 1887 the Eureka & Epicure Packing Co., the plants of Samuel Elmore, M. J. Kinney, and J. W. Seaborg, all of Astoria; J. O. Hanthorn & Co., Astoria; Fishermen's Packing Co., Astoria; Scandinavian Packing Co., Astoria; Columbia Canning Co., and J. W. & V. Cook, Clifton, were combined under the name of the Columbia River Packers Association. In 1889 the association built a new cannery at Rooster Rock. Mr. George was with the association until his death, but Mr. Barker left it to become general manager of the British Columbia Packers Association, where he is at present, the dean of the Pacific coast cannerymen.

Early in the eighties the California Can Co. was engaged in the business of making cans in San Francisco. Later the Pacific Sheet Metal Works absorbed the company. A factory was started at Astoria, with F. P. Kendall in charge. The latter was one of the deans of the industry and had a long and interesting connection with all branches of the industry and in most sections. The American Can Co. later on bought the Pacific Sheet Metal Works, and the Astoria plant was moved to Portland.

The American Can Co. was the first to install sanitary can-packing machinery in the salmon industry, the venture being made in 1911, at the Sanborn-Cutting plant in Astoria.

At the present time (1928) there are 24 canneries in operation on the river, while large quantities of salmon are also frozen, mild cured, pickled, smoked, and sold fresh in the markets of the world.

Commercial fishing is carried on mainly between the mouth of the Columbia and Celilo, a distance of about 200 miles, and in the Willamette River. The most of it is in the lower part of the river, within about 40 miles of its mouth. Bakers Bay, on the Washington or north side, and just within the river's mouth, is the favorite ground for pound-net fishing. The principal gill-net drifting ground is from the river's mouth to about 20 miles above Astoria, but drifting is done wherever convenient reaches are found much farther up the river. Most of the drag seines are hauled on the sandy bars in the river near Astoria, which are uncovered at low water. Wheels are operated in the upper river above the junction of the Willamette with the main river.

Astoria is the principal center for all branches of the industry, but more especially for canning. Other places in addition to Astoria at which canneries are located are Ilwaco, Eagle Cliff, Altoona, Brookfield, Pillar Rock, Cathlamet, Longview, Chinook, Ellsworth, and Pt. Ellice on the Washington shore, and at Warrendale, Rooster Rock, Rainier, Warrenton, Hammond, and Seuferts, on the Oregon shore.

OREGON

Necanicum Creek.—This short stream is in Clatsop County and enters the Pacific Ocean about 10 miles south of the Columbia River. Its fisheries are of small importance.

Nehalem River.—The Nehalem is a small coastal river that rises in the mountains of Clatsop and Columbia Counties, and flows into the Pacific Ocean in the northern part of Tillamook County. As early as 1887 there was a small cannery here, and the business has been followed ever since. In 1911 an additional plant was built and both have operated each year to 1919, except in 1913, when one was shut down. Since 1919 none have been operated except in 1922.

Tillamook Bay and River.—Tillamook River is a very short stream which enters Tillamook Bay, the latter being in Tillamook County and about 45 miles south of the mouth of the Columbia River.

Fishing is carried on mainly in the bay. The earliest record we have of canneries on this bay is of 1886, when two were in operation. From 1891 to 1910 but one was operated, but in 1911 another plant was started. In 1915 a third cannery was built, and all three operated until 1918, when only one was in operation. In 1919 two operated. In 1920 and 1921 both were shut down. Since then from one to three have been operated.

Nestugga River.—This stream enters the ocean in the southwestern part of Tillamook County. A cannery operated here in 1887 and the business was carried on each season with but one intermission until 1919. Since then it has been closed each year except in 1926.

Siletz River.—This river has its source in the mountains of Polk County and enters the ocean in the northern part of Lincoln County. The commercial development of the fisheries was hampered for many years owing to the fact that the river was within the boundaries of what was then the Siletz Indian Reservation. The first cannery was established here in 1896. An additional one was built in 1918. Since 1919 only one has been operated.

Yaquina Bay and River.—The Yaquina ("crooked") River is about 60 miles long; its general course is nearly west through the county of Benton. The river is narrow throughout the greater part of its length. A few miles from its mouth it suddenly broadens out into an estuary from one-half to three-fourths of a mile wide, which is commonly called Yaquina Bay. The river enters the Pacific about 100 miles south of the Columbia.

Salmon canning was begun on this river in 1887, when two small canneries were constructed. The next year an additional plant was erected. The business has fluctuated considerably since then and there is now but one cannery, which has not been operated since 1911. In 1917 this plant was consolidated with the one at Waldport.

The fishing grounds are all in the bay and the lower section of the river. The fishermen of this section are fortunate in that they have railroad communication with the outside world.

Alsea Bay and River.—Alsea River rises in the southwestern part of Benton County, and flows in nearly a northwesterly direction to the Pacific, a distance of about 60 miles. Like the Yaquina, the "bay" is merely a broadening out of the river just inside its mouth.

The first cannery was established in 1886 and by 1888 there were three in operation. For many years but one was operated. In 1911 and each season since up to 1919 two canneries have been operated. In 1920 and 1923–26 one was operated each year.

The best fishing grounds are from the mouth of the river to about 5 miles inland.

Siuslaw River.—This river has its source in the mountains of Lane County, and its course lies first in a northwesterly direction and to the westward until the Pacific is reached. Through part of its course it is the dividing line between Lane and Douglas Counties. In 1915 a railroad line from Eugene to the mouth of the Siuslaw River, at which point it connected with a line to the Coquille River, was opened for traffic.

As early as 1878 there were two canneries operated on this river, but from 1879 till 1888 there are no data available showing the extent of the fisheries. In 1888 the Florence Canning Co., the Lone Star Packing Co., and the Elmore Packing Co. each operated a cannery. In 1896 A. W. Hurd built a cannery which was destroyed by fire in 1908. No cannery has been operated since 1919. The opening of a railroad line from Eugene to here, thus furnishing an outlet for fresh salmon shipments, has greatly helped in developing its fisheries, and has cut off the supply of salmon for canning.

The salmon fishing grounds extend from near the mouth of the river to about 20 miles upstream.

Umpqua River.—With the exception of the Columbia this is the largest and longest river in Oregon. It is formed by north and south forks, which unite about 9 miles northwest of Roseburg, and the river then flows northwestwardly and enters the Pacific. Practically all of this river is within the boundaries of Douglas County, one of the largest counties in the State. A railroad has recently been built along this river and in time there will doubtless be a large development of the fisheries of this region owing to the opportunities which will be offered for shipping fresh fish.

With the exception of Rogue River, this is the only river in Oregon south of the Columbia River in which a spring run of chinook salmon occurs.

As early as 1878 there were two canneries located on the Umpqua, one of which was built by George W. Hume. The number has never been larger than this, and usually there has been but one operating. In 1912 there was but one at Gardiner. In 1919 one was operated. Since then but one has operated and this only in 1923, 1924, 1925, 1926, and 1927.

In 1918 the Reedsport Fish Co., of Reedsport, purchased the cannery of the Umpqua Cooperative Co., at Gardiner.

Coos Bay and River.—Coos Bay is a navigable semicircular inlet of the ocean with numerous arms or branches. There is much marshy ground in the bay, and a number of sloughs, or small creeks, which empty into the bay from both sides. Coos River proper is an unimportant stream, but a few miles in length. North Bend, Marshfield, and Empire are the principal towns on the bay. A branch railroad is being built to these points from the main line of the Southern Pacific Railway, and as soon as this is completed the fishing industry will receive a great impetus. Heretofore this region has depended upon steamers and sailing vessels plying to Portland and San Francisco for its communication with the outside world, and this slow and infrequent means of shipment has very seriously handicapped the fisheries.

Salmon canning began here in 1887, when two canneries opened for business. The business has fluctuated considerably since, most of the time but one cannery being operated; none has been operated since 1918.

Fishing is carried on mainly in the bay. A few set nets are operated in the river.

Coquille River.—This river is formed by three branches, called the North, Middle, and South Forks, which rise in the Umpqua Mountains and unite near Myrtle Point, the head of tidewater, about 45 miles by river from the mouth of the stream. It is a deep and sluggish river, with no natural obstructions to hinder the free passage of fish. Its fisheries have been seriously hampered by the lack of railroad communication, but this has recently been remedied, as the railroad to Coos Bay connects with a short line now in existence between the Coquille River and Coos Bay, and thence on to the Siuslaw and from there to Eugene.

The principal towns on the Coquille River are Bandon, Prosper, Coquille, and Myrtle Point. Bandon is the shipping port.

Pickled salmon were cured and shipped from this river very early, the first recorded instance of any considerable quantity being in 1877, when 3,000 barrels of salmon were sent to San Francisco. The salt shipments were important until within recent years. The first salmon cannery was erected in 1883, at Parkersburg. In 1886 another was built at the same place, and the following year still another was erected close by. This was the largest number ever in operation in any one year. Since 1909 two canneries have been operated, both at Prosper. In 1916 the Macleay estate took over the Coquille River Fishermen's Cooperative Co.'s cannery near Bandon. None of the canneries operated in 1928.

The fishing grounds are from the mouth to Myrtle Point, about 45 miles inland.

Sixes River.—This small river is located in the northern part of Curry County, and is about 40 miles in length, entering the Pacific a very short distance above Cape Blanco. The salmon caught here are either salted or shipped fresh to the canneries on the Coquille River.

Elk River.—This is another small stream about 40 miles in length, which enters the Pacific just south of Cape Blanco. As on the Sixes River, the salmon are either salted or sold fresh to the canneries on the Coquille River.

Rogue River.—This river has as its source Crater Lake in the Cascade Mountains, on the western border of Klamath County, flowing a distance of about 325 miles to the ocean, which it enters at Wedderburn. Its principal tributaries are the Illinois, Applegate, and Stewart Rivers. Owing to canyons and falls in the main river between the mouth of the Illinois River and Hellgate, the latter near Hogan Creek which runs through the town of Merlin, navigation and fishing are impossible in that section. Except at the mouth of the river the population is very sparse until about the neighborhood of Hogan Creek, where the river approaches the railroad, and from here on for some miles there are numerous growing towns.

Owing to the fact of there being both a spring and a fall run of salmon in this river, the fisheries early became of importance, although sadly hampered because of being compelled to depend wholly on vessel communication with San Francisco, many miles away. In the early years the salmon were pickled and shipped to San Francisco. Strong, Baldwin & Co. started in the business as early as 1859. In 1877 R. D. Hume, who had been canning salmon on the Columbia River, removed to the Rogue River, and established near the mouth a cannery which he operated every season (except 1894, when the cannery burned down) until his death in November, 1908, after which date it was operated by his heirs. Mr. Hume also operated a large cold-storage plant at Wedderburn for several years.

The development of the fisheries of the lower Rogue River was very much hampered by the monopoly which Mr. Hume acquired and maintained until his death. He bought both shores of the river for 12 miles from its mouth, and also owned an unbroken frontage on the ocean shore extending 7 miles north from the mouth of the river. As a result of this, independent fishermen could find no convenient places for landing, which was necessary in order to cure, handle, and ship the fish caught. Since Mr. Hume's death the property has been sold to the Macleay estate, but the people of Oregon, upon an initiative and referendum petition, voted in 1910 to close Rogue River to all commercial fishing, and it was so closed in 1911 and 1912 but reopened in 1913. A second cannery was built here in 1915 by the Seaborg Canning Co. A third cannery was built in 1919, but during the period from 1921 to 1926 but one was operated. Two operated in 1927 and 1928.

In the upper river ranchers living along the banks have engaged in fishing for a number of years, the catch for the most part being sold fresh. In recent years, as the country has developed, this fishery has become fairly important.

Chetco and Windchuck Rivers.—These two unimportant streams empty into the Pacific in the lower part of Curry County, not far from the California line. The former is about 20 miles and the latter about 25 miles in length. Both have runs of salmon, and small fisheries have been maintained for some years, the catch being either pickled or sold to the California canneries.

CALIFORNIA

Smith River.—This river, which is the most northerly one in the State, rises near the Siskiyou Mountains, and runs in a westerly direction to the Pacific Ocean.

The river has only a spring run of salmon, and the early recorded history of the fisheries is fragmentary. The pickling of salmon was the main business at first and has been important ever since, as the cannery, which was first established in 1878, operated irregularly, and seems to have shut down entirely in 1895. Canning began again in 1914 by H. E. Westbrook and has been prosecuted in various years since.

Klamath River.—This is the most important river in California north of the Sacramento. It issues from the Lower Klamath Lake in Klamath County, Oreg., and runs southwesterly across Siskiyou County, passes through the southeastern section of Del Norte County, keeping its southerly course into Humboldt County, where it forms a junction with the Trinity River, and thence its course is directed to the northwest until it reaches the Pacific Ocean.

The Klamath River is important as a salmon stream because it has both a spring and fall run of salmon. In 1888 a cannery was established at Requa, at the mouth, and this has been operated occasionally ever since. The pickling of salmon has been done here for a number of years. Some years part of the catch has been shipped fresh to the cannery on Smith River or to the Rogue River (Oreg.) cannery. Since 1909 the cannery has been operated continuously by the Klamath River Packers Association.

Humboldt Bay and tributaries.—The shore line of Humboldt County is bold and high, except in the vicinity of Humboldt Bay, where it is rather flat. The latter is the only harbor along the county shore, and it is quite difficult of access, owing to the bar at the entrance upon which the sea breaks quite heavily. The bay is about 12 miles long and about 3 miles wide. Mad River, which has its rise in the lower part of Trinity County, runs in a northwesterly direction, then makes a sharp turn and enters the bay from the north side. Eel River, which has its rise in Lake County, far to the southeast, runs in a northwesterly direction and enters the bay at its southern extremity. Small railroads running south from Eureka traverse the shores of both rivers for some miles. A railroad now runs from the north side of San Francisco Bay to Eureka, and it has aided very materially in extending the market for salmon caught in these rivers.

Mattole River.—This is a small and unimportant river in the southern part of Humboldt County and is said to have a good run of salmon each year, but no commercial fishing has as yet been carried on here.

Noyo River.—In 1915 salmon fishing began at Fort Bragg, in Mendocino County, where the Noyo River debouches into the ocean. The building of a branch railroad to this point made the shipping of salmon a possibility. In 1915 and 1916 considerable salmon were caught and shipped fresh. In 1917 the Tillamook Ice & Cold Storage Co. built and operated a cannery here, while the Columbia & Northern Fishing & Packing Co. in the same year built and operated a cold-storage and mild-curing plant. The cannery has not been operated since 1920.

Sacramento and San Joaquin Rivers.—These two rivers are the most important rivers in California. The Sacramento is quite crooked, the distance by river from Red Bluff to San Francisco being about 375 miles, while the distance by rail between these two places is only 225 miles. The river rises in several small lakes in the mountains about 20 miles west of the town of Mount Shasta (formerly known as Sisson), in Siskiyou County, and for nearly half its length flows through a narrow canyon. The upper portion is a typical mountain stream, with innumerable pools and rapids. A little above Redding the river emerges from the canyon and widens into a broad, shallow stream. Below Sacramento it runs through a level country and is affected by tides. Sloughs are numerous in this stretch, some connecting it with the San Joaquin. The Sacramento and San Joaquin Rivers join as they empty into Suisun Bay.

The principal tributaries of the Sacramento which are frequented by salmon are the Pit and McCloud Rivers and Battle Creek. At one time salmon frequented the American and Feather Rivers, but mining and irrigation operations along these streams either killed them off or drove them away.

The San Joaquin River has its source in the Sierra Nevada Mountains. Flowing westerly and forming the boundary between Fresno and Madera Counties for a considerable distance, it then turns abruptly to the north just where it is joined by Fresno Slough, which drains Lake Tulare. From here its general course is northwesterly until it joins the Sacramento River, near the latter's mouth. The Chouchilla and Fresno Rivers are the principal tributaries of the San Joaquin.

The principal fishing grounds for salmon are Suisun Bay, the lower part of San Joaquin River, and the Sacramento River as high as the vicinity of Sacramento. Drift gill nets are used almost exclusively in this section. From Sacramento to Anderson there is considerable commercial fishing, more particularly with haul seines.

Owing to the early and excellent railroad facilities which the fisheries of the Sacramento River have enjoyed, they have not been handicapped so seriously as most of the other Pacific coast rivers in finding profitable outlets for the catch. Soon after the first transcontinental line was opened the shipping of fresh salmon to eastern points began, and it has been an important feature of the industry ever since.

The chief event in the history of the salmon fisheries of this river is the fact that the canning of salmon on the Pacific coast had its inception here in 1864. The circumstances leading up to this event and its consummation are interestingly told by R. D. Hume in the following words:

> The first salmon cannery of the United States was located at Washington, Yolo County, Calif. A part of the building was originally a cabin situated on the river bank outside of the levee just opposite the foot of K Street, Sacramento City. It was built in 1852 and occupied by James Booker, Percy Woodsom, and William Hume. William Hume came to California in the spring of 1852, bringing with him a salmon gill net which he had made before leaving his home at Augusta, Me. In company with James Booker and Percy Woodsom, Mr. Hume began fishing for salmon in the Sacramento River just in front of the city of Sacramento. William Hume had been salmon fishing in the Kennebec River in the State of Maine with his father, where his father and grandfather had been engaged in the same business since 1780, and their ancestors in Scotland had for pleasure pursued the sportive salmon on the Tweed and Tay for centuries before. In 1856 William Hume went back to Maine, and on his return to California the same year was accompanied by his brothers, John and G. W. Hume, who also engaged in salmon fishing in the Sacramento River. Among the schoolmates of G. W. Hume was one Andrew S. Hapgood, who had learned the tinsmith's trade, and who a short time after G. W. Hume left for California went to Boston and entered the employ of J. B. Hamblen, a pioneer in the canning business, and was sent by him to Fox Island on the coast of Maine to engage in canning lobsters. The canning of lobster was a new and growing industry, and Mr. Hamblen, to increase his business, a short time after sent Mr. Hapgood to the Bay of Chaleur, an arm of the sea which divides the Province of Quebec from that of New Brunswick, where, in addition to the canning of lobster, they also canned a few salmon. I believe this was the first salmon canned on the American Continent, and I am informed that the business in a small way is still carried on in that section of the country. In 1863 G. W. Hume went back to Maine, and while there visited Mr. Hapgood at Fox Island, to which place he had been again sent by J. B. Hamblen to take charge of the works at that place. During the visit of G. W. Hume to his friend Hapgood a talk about salmon was had, and it was agreed that if salmon on the Pacific coast were as plentiful as represented by Mr. Hume much money could be made in a salmon-cannery business. The plan decided on was that G. W. Hume, on his return to California, should try to induce his brother William to engage in the business with them, and, if he succeeded in so doing, Mr. Hapgood should purchase the necessary machinery and come out to California in time for the spring season of 1864. William Hume being agreeable to take part in the enterprise,

Mr. Hapgood set out on the journey and arrived at San Francisco on March 23, 1864, and a few days later at the location where the operations were afterwards conducted.[16]

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For a considerable time after the salmon-canning business was inaugurated the packers suspended operations in the early part of July of each year as at that time the market would take only goods which showed a rich oil and the best food values.[17]

The business languished after the firm established its cannery on the Columbia River, but in 1874 was renewed again by others and continued with varying success until 1905, when it ceased temporarily, owing to the smaller quantity of fish available and the difficulty of competing with the mild-cure packers and the fresh-fish dealers. Several times since small packs have been made when, for some reason, mild-curing was unprofitable.

Monterey Bay.—The first harbor south of San Francisco is Monterey Bay, a large indentation cutting into Santa Cruz and Monterey Counties. Only a portion of it is well sheltered, however. For a number of years it had been known that salmon frequented the waters of this bay for the purpose of feeding on the young fishes which swarmed there. Sportsmen frequently caught them with rod and reel, but it was not until the early eighties that the industry was established on a commercial basis. It has since grown very rapidly. The catch has either been mild cured at Monterey or shipped fresh. A few have been canned in recent years.

ALASKA [18]

Alaska is the most favored salmon-fishing region. Many rivers, some of great length and draining enormous areas, intersect the district in every direction, while the number of small creeks is countless. Almost every one of these have runs of salmon of varying abundance. The principal streams entering Bering Sea are the Yukon, Kuskokwim, Togiak, Nushagak, Kvichak, Naknek, Egegik, and Ugashik; in Central Alaska the Chignik, Karluk, Alitak, Susitna, and Copper Rivers are the main streams, while in southeast Alaska are found, among many others, the Ankow, Situk, Alsek, Chilkat, Chilkoot, Taku, Stikine, and Unuk Rivers. Most of the fishing in Alaska is carried on in the bays into which these rivers debouch. In southeast Alaska, which is composed largely of islands, the fishing is carried on mainly in the bays, sounds, and straits among these.

Even before the purchase of the district from Russia in 1867 our fishermen occasionally resorted to southeast Alaska and prepared salted salmon. The salmon fisheries did not become important, however, until canning was begun.

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[16] The description of the machinery used and the methods of canning have been quoted in full under "Canning" elsewhere in this report.

[17] The First Salmon Cannery. By R. D. Hume. Pacific Fisherman, Seattle, Wash., Vol. II, No. 1, January, 1904, pp. 19-21.

[18] The material for the history of the salmon fisheries of Alaska for the period from the inception of salmon canning to 1900 was obtained almost wholly from the following excellent and valuable reports by Capt. Jefferson F. Moser, to whom I am deeply indebted for this and other valuable data.

The Salmon and Salmon Fisheries of Alaska. Report of the Operations of the United States Fish Commission Steamer *Albatross* for the year ended June 30, 1898. By Jefferson F. Moser. Bulletin, U. S. Fish Commission, 1898, Vol. XVIII, pp. 1-178. Washington, 1899.

Alaska Salmon Investigations in 1900 and 1901. By Jefferson F. Moser. Bulletin, U. S. Fish Commission, 1901, Vol. XXI, pp. 173-398. Washington, 1902.

SOUTHEAST ALASKA

One of the most favorable sections for carrying on fishing operations is southeast Alaska. Here a narrow strip of mainland, about 30 miles wide, separates British Columbia from salt water and forms the "panhandle" of Alaska. Outside this is a fringe of numerous islands, large and small, close to the coast line, conforming to its irregularities and separated from it and from each other by deep straits and channels. These islands, about 1,100 in number, extend from the coast an average distance of about 75 miles and along the general contour for about 250 miles. Some of these islands are very large, indented with deep bays and sounds, and they in turn fringed with smaller islands.

The largest streams in this region are the Unuk, Stikine, Taku, and Chilkat, all of which take their source in the interior and drain considerable areas. The other rivers are usually streams, and the greater number are simply outlets to a lake or system of lakes.

All species of salmon are to be found in this region, but the humpback is by far the most abundant.

This region has been the favorite fishing ground for the smaller operators, although a few of the largest canneries in Alaska are located here. Of recent years transportation facilities have been exceedingly good and fairly cheap, while the nearness to the States and the considerable resident population which could be drawn upon for labor have been big factors in its development.

The Russians did considerable salting of salmon. Petroff, in his report in the Tenth Census on the "Population, industries, and resources of Alaska," writes as follows of the Redoubt near Sitka: "The once famous Redoubt or deep-lake salmon fishery on Baranof Island, which at one time during the Russian rule supplied this whole region, and whence 2,000 barrels of salmon were shipped in 1868, now lies idle."

Bancroft [19] in speaking of the king salmon of Alaska says: "So choice is its flavor, that during the règime of the Russian American Co. several barrels of the salted fish were shipped each season to St. Petersburg for the use of the friends of the company's officials."

One of the earliest operators in southeast Alaska was a Greek, or Slav, named Baronovich, who married the daughter of Skowl, one of the old-time chiefs of the Kasaans, and received from him the fishery on Karta Bay, a part of Kasaan Bay, and one of the best red salmon streams south of Wrangell Narrows. Baronovich built a saltery here, kept a store, and traded with the Indians. He died some years ago, and for some time after his death his sons operated it. It finally collapsed several years ago.

For a number of years a saltery was operated at Klawak, on the west coast of Prince of Wales Island. In 1878 the North Pacific Trading & Packing Co. purchased the saltery and erected the first cannery in Alaska here. A pack was made the same year, and the plant has operated every year since. In 1899 the cannery burned down, but it was immediately rebuilt on the opposite side of the bay. For some years this plant was operated almost exclusively with native labor, and at present the majority employed are natives.

The same year that the above cannery was established the Cutting Packing Co. built a cannery at old Sitka, and operated it in 1878

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[19] History of Alaska, Vol. XXXIII, p. 661. By Hubert Howe Bancroft. San Francisco, 1886.

and 1879, then it was closed down. In 1882 the machinery was taken by another company to Cook Inlet.

In 1882 M. J. Kinney, of Astoria, under the name of the Chilkat Packing Co., built a cannery on the eastern shore of Chilkat Inlet and made a pack the same year. The cannery changed hands several times and finally was burned in 1892, and not rebuilt. The cannery packed every year from 1883 to 1891, both inclusive, except in 1888, when it was closed.

In 1883 the Northwest Trading Co. built a cannery on Pyramid Harbor, a little bay on the western side of Chilkat Inlet. It was operated by this company in 1883 and 1884, was idle in 1885, and in 1888 was sold to D. L. Beck & Sons, of San Francisco, and operated by that firm. In the spring of 1889, it was burned, but was rebuilt at once and a pack made that year. In 1893 it joined the Alaska Packers Association, which operated it, except in 1905, until the end of the season of 1908, when it was finally abandoned.

On the north shore of Boca de Quadra, about 8 miles from the entrance, a cannery was built in 1883 by M. J. Kinney, of Astoria, and operated under the name of the Cape Fox Packing Co. from 1883 to 1886. Late in the last-named year it was sold and moved to Ketchikan, operating there under the name of the Tongass Packing Co. during 1887, 1888, and until August, 1889, when it was burned and not rebuilt.

In 1886 Rhode & Johnson erected a saltery at Yes Bay. The following year the firm became Ford, Rhode & Johnson. In 1887 work was begun on a cannery which was finished in 1888. Packing was begun in 1889 under the name of the Boston Fishing & Trading Co. In 1901 it was included in the Pacific Packing & Navigation Co. consolidation, and when that concern failed was purchased in 1905 by the Northwestern Fisheries Co. In 1906 the cannery was purchased by C. A. Burckhardt & Co., who have operated it each year to date, either under that name or subsequent incorporations known as the Yes Bay Canning Co. and the Alaska Pacific Fisheries.

In 1887 the Aberdeen Packing Co., of Astoria, Oreg., built a cannery on the Stikine River, about 8 miles above the mouth. In 1889 the cannery was moved to Point Highfield, on the northern end of Wrangell Island, and operations commenced under the name of the Glacier Packing Co. In 1893 it joined the Alaska Packers Association, who have operated it continuously, except in 1905, until it was finally shut down at the end of the 1926 season.

The Loring cannery of the Alaska Packers Association was built in 1888 by the Alaska Salmon Packing & Fur Co., of San Francisco, and operated by the Cutting Packing Co. The company was incorporated in 1883 and operated a saltery until the cannery was built. When the Alaska Packers Association was formed in 1893 it joined that organization. The cannery has operated every year since it was built, and in some seasons has made the largest pack of any in the Territory.

Shortly after William Duncan and his community of Tsimpsean Indians had settled, in 1887, on Annette Island, which island had been set aside by the Federal Government as a reserve for them, plans were under way for a salmon cannery, but funds came in so slowly that it was not until 1890 that any pack was attempted. In 1891 it was in full operation, and operated from then continuously until 1913, when the plant was shut down for that and the two succeeding years. Much dissatisfaction had been expressed by the natives over the operation of this and other industrial plants on the island, and finally the Federal authorities took possession of practically everything, as guardian of the natives, and early in 1916 leased the cannery to P. E. Harris & Co., of Seattle, the understanding being that they were to employ natives when available. Unfortunately the plant burned down on May 17, just before the fishing season began. In 1918 the Annette Island Packing Co. built and operated a cannery here and has continued to do so to date.

For the purpose of assisting the natives of Annette Island in operating this cannery the President in 1916 issued a proclamation making a fishery reserve of the island and among other things provided that—

the waters within 3,000 feet from the shore lines at mean low tide of Annette Island, Ham Island, Walker Island, Lewis Island, Spire Island, Hemlock Island, and adjacent rocks and islets, located within the area segregated by the broken line upon the diagram hereto attached, and made a part of the proclamation, also the bays of said islands, rocks, and islets are hereby reserved for the benefit of the Metlakahtlans and such other Alaskan natives as have joined them or may join them in residence on these islands, to be used by them under the general fisheries laws and regulations of the United States as administered by the Secretary of Commerce.

One white trap-net owner refused to remove his trap from the waters in question, and when decision was rendered against him in the lower court, carried the case to the United States Supreme Court, which, in December, 1918, upheld the right of the President to grant exclusive fishing rights in public waters.

James Miller operated a saltery on Burroughs Bay, on Behm Canal, in 1886 and 1887. In 1888 Andrew and Benjamin Young, of Astoria, Oreg., built a cannery here and operated it under the name of the Cape Lees Packing Co. in 1888, 1889, and 1890. It was closed in 1891 and 1892. In 1893 it became a part of the Alaska Packers Association, and was dismantled the following year.

About 1888 a saltery was established on Thorne Bay, Prince of Wales Island. The following year it was sold to the Loring cannery. In 1892 it was sold to Robert Bell, who moved it to the upper end of the northwest arm, on the western shore. Salting was not carried on each season, as it was sometimes found to be more profitable to sell the fish fresh to the canneries. The plant was finally abandoned.

In 1889 Messrs. Sanborn and Ellmore, of Astoria, built a cannery in Pavlof Harbor, Freshwater Bay, on the eastern side of Chichagof Island, and operated it under the name of the Astoria & Alaska Packing Co. It made a pack that year and in the spring of 1890 was moved to Point Ellis, on the eastern side of Kuiu Island, packing that year and also in 1891. It was burned in May, 1892. Only one building was left standing, and it and the site were purchased by John H. Mantle, of Wrangell, who operated a saltery on each arm of the bay. Mr. Mantle began operations here in 1893.

In 1889 the Baranof Packing Co. built and first operated a cannery at the Redoubt, about 12 miles below Sitka. It was also operated in 1890 and then moved to Redfish Bay, on the western coast of Baranof Island. It made its first pack here in 1891 and was then operated every year until 1898, when it was sold to the Alaska Packers Association and dismantled.

In 1889 the Thlinket Packing Co., organized at Portland, Oreg., built a cannery at Point Gerard, on the mainland opposite Point

Highfield, at the head of Wrangell Island. It was operated that and the subsequent year.

In 1901 this company built another cannery at Santa Anna, on the north side of Cleveland Peninsula, and made a pack the same year.

In 1901 both plants became part of the Pacific Packing & Navigation Co. In 1902 the Gerard Point plant was closed and was not opened again. In 1903, 1904, and 1905 the Santa Anna plant was closed also. Early in 1905 these plants were purchased by the Northwestern Fisheries Co. at the assignee's sale of the old corporation's properties. The Santa Anna plant was operated in 1906 and each year since up to the end of the 1920 season.

The Chilkat Canning Co. put up a plant at Chilkat village, on Chilkat Inlet, in 1889. It was operated from 1889 to 1893, and then sold to the Alaska Packers Association. It was held in reserve for some years but was finally dismantled.

In 1890 a cannery was built by the Bartlett Bay Packing Co. on Bartlett Bay, Icy Straits, and operated by Williams, Brown & Co., of San Francisco. A saltery was contructed here prior to that date, and in 1889 a pack of 4,300 cases was made in a crude way. In 1891 the ice piled up in Glacier Bay to such an extent that the cannery could do almost nothing. It was not operated after this date. In 1893 it became a part of the Alaska Packers Association and was dismantled in 1894.

In 1896 the Pacific Steam Whaling Co. built a cannery on the northern side of Hunter Bay, near the southern end of Prince of Wales Island, and made a pack the same year. Miller & Co. had a saltery at this place and it was purchased by the company and removed to make room for the cannery. Miller & Co. also had a saltery on Nutqua Inlet, which was built in 1896, and this also was sold to the canning company. In 1901 the cannery became a part of the Pacific Packing & Navigation Co. It was closed in 1904. Upon the dissolution of the company in 1905 this plant was purchased by the Northwestern Fisheries Co., which company, after keeping it closed in 1905 and 1906, has operated it intermittently since.

The Quadra Packing Co. built a cannery on Mink Arm, in Boca de Quadra, in the spring of 1896 and made its first pack that year. In 1901 the plant was purchased by the Pacific Packing & Navigation Co. It was closed in 1904, 1905, and 1906. Upon the dissolution of the company in 1905 the plant was purchased by the Northwestern Fisheries Co. It was reopened in 1907 and has been operated intermittently since.

In 1899 the Icy Straits Packing Co., consisting of stockholders of the Quadra Packing Co., built a cannery and sawmill at a point on the southeastern shore of Wrangell Narrows, about a mile south of the northern entrance to same, and named the town site Petersburg. The cannery was ready and operated in 1900. In 1901 it became a part of the Pacific Packing & Navigation Co. It was closed in 1903, 1904, and 1905. In 1905 it was purchased at the sale of the company's properties by the Northwestern Fisheries Co. In 1906 the Pacific Coast & Norway Packing Co., which had been operating a cannery at Tonka, on Wrangell Narrows, purchased this plant and transferred its activities to the latter. In 1915 the plant was leased to the Petersburg Packing Co., composed of stockholders of the old company.

In 1900 the Western Fisheries Co., of Portland, built a cannery at the head of Dundas Bay, and made a pack the same year. In 1901 it became a part of the Pacific Packing & Navigation Co. It was closed in 1904. At the assignee's sale of the company's properties in 1905 this plant was purchased by the Northwestern Fisheries Co. and operated in 1905 and most years since.

In 1900 the Fidalgo Island Packing Co. built a cannery on the southern side of Ketchikan Creek. A pack was made the same year. The plant was closed in 1903, only a little salting being done that year, was reopened in 1904, was closed again in 1905, and was reopened in 1906, since when it has been operated each season to date, except in 1909.

In 1900 the Pacific Coast & Norway Packing Co. operated a floating saltery while prospecting for a cannery location. In 1901 the company built a cannery at Tonka, about midway of Wrangell Narrows, on the western side, and made a pack in that and subsequent years until 1906. In that year the company purchased the Petersburg cannery and thenceforth operated from there. The Tonka plant was dismantled a few years later.

In 1900 the Royer-Warnock Packing Co., of San Francisco, built a small cannery on Beecher Pass, which connects Duncan Canal with Wrangell Narrows, using the old Buck saltery for the cannery proper. It operated only the one season. It was a hand-pack plant.

The Taku Fishing Co. in 1900 built a cannery on the southern side of the entrance to Port Snettisham, and made a pack in that year. In 1901 it became a part of the Pacific Packing & Navigation Co. The plant was closed in 1902 and not reopened again.

In 1900 the Taku Packing Co., organized in Astoria, Oreg., built a cannery on the western shore of Taku Inlet and made a pack the same year. In 1901 it became a part of the Pacific Packing & Navigation Co. It was closed in 1904 and not reopened again. In 1905 it became the property of the Northwestern Fisheries Co.

In 1900 the Chilkoot Packing Co., organized at Aberdeen, Wash., built a cannery at the head of Chilkoot Inlet, and operated the same year. In 1901 it became a part of the Pacific Packing & Navigation Co. It was closed in 1904 and not reopened again.

The Pacific Packing & Navigation Co. (an account of whose inception, operation, and failure appears under Puget Sound) was organized in 1901 and acquired the following canneries in Alaska: Canneries of Pacific Steam Whaling Co. at Nushagak, Bristol Bay; Chignik, Alaska Peninsula; Uyak, Kodiak Island; Kenai, Cook Inlet; Orca, Prince William Sound; Hunter Bay, southeast Alaska. Also the Hume Bros. & Hume canneries at Chignik and Uyak; the Thlinket Packing Co. with canneries at Gerard Point and Santa Anna; the Western Fisheries Co. cannery at Dundas Bay, Icy Straits; Chilkoot Packing Co. cannery at Chilkoot Inlet; the Taku Packing Co. cannery at Taku Inlet; the Taku Fishing Co. cannery at Port Snettisham; the Boston Fishing & Trading Co. cannery at Yes Bay; the Chatham Straits Packing Co. cannery on Sitkoh Bay; the Icy Straits Packing Co. cannery at Petersburg, Wrangell Narrows; and the Quadra Packing Co. cannery at Mink Arm, Boca de Quadra.

The company met with financial disaster in 1904, and at the resulting sale most of its properties were bought by the Northwestern Fisheries Co., a corporation formed for the purpose. Of the

Alaska canneries the Sitkoh Bay plant was sold to George T. Myers & Co., while the Orca plant was leased to Capt. Omar J. Humphreys, from whom the Northwestern Fisheries Co. later on secured it.

The San Juan Fishing & Packing Co., of Seattle, established a cannery and cold-storage plant in 1901 at Taku Harbor, a small bay on the mainland a short distance south of Taku Inlet, and made a pack the same year. This plant was purchased in 1903 by the Pacific Cold Storage Co. and operated by it in 1903, 1904, and 1905. In 1906 it was leased and operated by the Taku-Alaska Packing Co. From 1907 to 1911 the plant was leased and operated by John L. Carlson & Co. In 1911 the plant was purchased by Mr. Carlson and the name changed to the Taku Canning & Cold Storage Co., under which name it has been operated each year since. In 1918 it was purchased by Libby, McNeill & Libby, who have operated it since.

In 1901 the Chatham Straits Packing Co. built a cannery on Sitkoh Bay, Chichagof Island. The same year this cannery became a part of the Pacific Packing & Navigation Co. Upon the dissolution of the latter, early in 1905, this plant was purchased by George T. Myers & Co., which company has operated it to date without a break.

In 1901 F. C. Barnes, of Portland, Oreg., built a cannery at Lake Bay, on the east side of Prince of Wales Island, and made a pack that season. This cannery was operated in 1902, but was closed in 1903. It was reopened in 1904, and operated each season after that. In 1910 it was incorporated under the name of F. C. Barnes Co.

In 1901 the Union Packing Co., organized in Tacoma, Wash., built a cannery on Kell Bay, an arm of Affleck Canal, on the southern side of Kuiu Island. In 1904 this plant was moved to the Kvichak River in Bering Sea.

In 1902 the Kasaan Bay Co. built a cannery on the north side of Kasaan Bay, Prince of Wales Island, and made a pack the same year. It was shut down in 1904 and 1905, but reopened in 1906 by Gorman & Co., of Seattle, who had purchased control of the company. Shortly after the closing of the packing season the plant burned down, but it was rebuilt in time to operate the following season. In 1909 the plant was closed, but was reopened in 1910. On September 12 of that year the plant was again destroyed by fire, but was rebuilt in time to operate the following season. On October 29, 1911, the plant was once more destroyed by fire, but was rebuilt in time to operate in 1912. In 1915 the plant was purchased by the Anacortes Fisheries Co., a subsidiary of the Booth Fisheries Co., who operated it each year until the close of 1920. In 1921 the Anacortes Fisheries Co. was dissolved and its canneries were transferred to the Northwestern Fisheries Co., also a subsidiary of the Booth Fisheries Co. The Kasaan plant was closed that year but has been operated each year since.

In 1902 the Alaska Fish & Lumber Co. built a cannery at Shakan, on Kosciusko Island, near the head of Prince of Wales Island, and made a pack the same year. It was shut down in 1904. In 1905 the property was taken over by the Shakan Salmon Co., a new company composed largely of members of the old corporation, who operated it that season. In 1906 Gorman & Co., of Seattle, obtained control of this cannery and operated it each season under the name of the Shakan Salmon Co. until 1915, when it was sold to the Anacortes Fisheries Co., a subsidiary of the Booth Fisheries Co. The plant was idle in 1921 and 1922, but has been operated each year since by the Northwestern Fisheries Co.

In 1902 the Columbia Canning Co. built a cannery on the southern side of Chilkoot Inlet, and made a pack that year. In 1910 C. A. Burckhardt & Co., under the name of the Chilkoot Fisheries Co., purchased and operated this plant. In 1911 the name was changed to the Alaska Pacific Fisheries. Early in 1919 the plant was totally destroyed by fire.

The only cannery in this section lost to Alaska by action of the Federal Government was that of the Wales Island Packing Co., which was built on Wales Island, near Dixon Entrance, in 1902. When the Alaska Boundary Arbitration Commission declared Wales Island a part of Canada in 1903, this cannery automatically ceased to be an American one. After the change of government it lay idle for some time, but later was put in use once more by Canadian parties.

In 1902 the Thlinket Packing Co. built a cannery on Funter Bay, on the west side of Admiralty Island, and made a pack that year and every subsequent year until 1926, when it sold the plant to the Sunny Point Packing Co., who continued operations thereafter.

In 1902 the Pillar Bay Packing Co. built and operated a cannery near Point Ellis, on Kuiu Island, and operated it until 1918, when it was sold to the Fidalgo Island Packing Co., who have since operated it.

In 1902 the Alaska Fisheries Union, organized in Seattle, built a cannery on the east side of Chilkat Inlet, and made a pack that year. After operating to 1905, the plant was in that year leased to and operated by the Lynn Canal Packing Co. The plant was purchased in 1906 by the Pacific American Fisheries. In 1908 it was moved to Excursion Inlet and has been operated each season to date.

The Tacoma Fishing Co. in 1902 established a saltery and halibut station at Tee Harbor, on Lynn Canal, and made a pack that year. Later it became the property of the International Fisheries Co. In 1910 the plant was purchased by the Tee Harbor Packing Co., which established a cannery and operated first in 1911. Thereafter the plant was operated each season, with changes of ownership in 1920 and 1922, until the fall of 1924, when it was destroyed by fire and was not rebuilt.

In 1907 the Alsek Fisheries Co. did some salting on the Alsek River. The late Malcolm Campbell was interested in the above company and in subsequent years operated under his own name. In 1910 the St. Elias Packing Co. established a cannery near the saltery and made a pack the same year, and in 1911 and 1912. Since then the plant has been closed and was sold in 1916 to Libby, McNeill & Libby.

The Astoria & Puget Sound Packing Co., in 1908, built and operated a cannery on Excursion Inlet. It was closed the following year, but has been operated each year since. It was burned in 1917, but was rebuilt in time to operate the following season.

The year 1911 witnessed a considerable increase in the number of canneries. Among the new plants built and operated were the following: Hidden Inlet Canning Co., Hidden Inlet, Portland Canal; Hawk Fish Co. (later changed to P. E. Harris & Co.), Hawk Inlet, Admiralty Island; Lindenberger Packing Co., Roe Point, Behm Canal; Deep Sea Salmon Co., Cape Edwards, Chichagof Island; L. Gustave & Co., Skowl Arm, Prince of Wales Island (changed in 1912 to Skowl Arm Packing Co.), and M. E. Lane (a small hand-pack plant), Meyers Chuck, Cleveland Peninsula.

An innovation in Alaska salmon canning this year was when the old ship *Glory of the Seas* was fitted out as a floating cannery by the Alaska Fish Co., and operated in Hawk Inlet, Admiralty Island, and at Ketchikan. Quarters for the crew were built over the cabins on the quarter deck, the latter being reserved for officials. The remainder of the upper deck was used for receiving, dressing, and cleaning the fish, which were brought on board by means of a portable elevator attached to the side of the ship. The "iron chink" and the sliming and cleaning tanks were also on this deck. The fish were carried in chutes to the second deck, where a line of sanitary machinery had been installed. The retorts were placed on the forward part of the second deck. The third deck was used for cooling and storing the pack. No lacquering or labeling was carried on aboard the vessel.

In 1912 this plant and the ship *William H. Smith*, the latter by the Weiding & Independent Fisheries Co., of Seattle, were operated. The *William H. Smith* also did some freezing of salmon.

Yakutat Bay is the only harbor available for vessels from Cape Spencer to Prince William Sound. In 1902 C. A. Fredericks & Co., of Seattle; Mulvey & Wilson, of Yakutat; Jewell Fish Co.; and Ankow Fish Co. all established salteries here. While their primary purpose was the salting of herring, considerable salmon was also salted. These plants operated only the one season.

In 1904 the Yakutat & Southern Railway Co. built a cannery here. This plant is noted for being the only one that hauls its fish by railway from the fishing streams to the cannery. The railroad is a little over 9 miles in length, and for some years an engine which had seen service on the elevated railroads of New York City and was discarded when the latter were electrified was used. A more modern engine is now in use. The fish are carried in open freight cars. Later this company was purchased by Gorman & Co., and now is the property of Libby, McNeill & Libby.

Nineteen new canneries were built and operated in southeast Alaska in 1912, while 1 new cannery was built in 1914, 2 in 1915, and 7 in 1916. In 1917 the heavy demand created for foodstuffs by the World War caused a considerable increase in the number of new canneries in Alaska. In the southeast Alaska section 9 were built and operated in that year. This demand persisted into 1918, 1919, and 1920. In 1918, 15 new canneries were built and operated; in 1919, 9; and in 1920, 8. Since then hardly a year has passed without one or more new plants being put into use; and while each year a few were shut down temporarily or abandoned entirely, the total number has tended to increase.

Although the war ended late in 1918, the demand for canned salmon continued strong into 1920. The diminution in demand which the more far-sighted packers had anticipated and prepared for started late in 1920, and for several years the industry went through a rather severe period of readjustment during which a number of canneries were closed down permanently and others temporarily. This expensive experience brought home to some of the operators the fact that the industry had been overbuilt, and numerous attempts since have been made looking to the consolidation of the independent plants into groups, which would vastly decrease the enormous overhead of the individual companies and also lead to other economies. Practically all of these attempts were failures, however. Three of the strongest groups financially, however, have tended to ease the situation somewhat by buying outright various other competing canneries.

There are still too many canneries operating in the southeast Alaska section, and the only measure of relief that will meet the situation would be a material reduction in the number. This would not mean a reduction in the total pack, as the industry has reached a stage where the intrusion of a new cannery merely means that its pack correspondingly reduces the pack of its near-by competitors. As the pack of the southeast Alaska canneries is mainly of low-grade species in the sale of which heavy competition exists, the undue expansion of the number of companies operating tends to greatly enhance the cost of operation, and unless this is very materially reduced in the near future our operators are going to be greatly handicapped in the world's markets.

Salmon salteries.—At one time salteries were of considerable importance in this section, but the establishment of canneries, with the consequent heavy demand for fresh salmon, induced most of the salteries to sell their high-grade fish to the canneries and pack only the cheaper grades. Many of them quit the business as a result of the competition, while others were forced out by the low prices prevailing at times for salted salmon. As many of the salters moved from place to place, and frequently changed their operating name, it has been difficult to keep track of them, and in this review only those are listed who attained to some prominence either through longevity or largeness of pack.

James Millar, one of the earliest whites to take up his residence here after the purchase of Alaska, and his sons were very active in starting and operating salteries, and it was an unusual thing during the period previous to 1910 when one of the family was not operating such a plant.

Jacob Louth established a saltery on the south arm of Moira Sound about 1900 and operated it for some years.

John C. Frey established a saltery on Etolin Island in the nineties and ran it until his death in 1904, when John H. Mantle purchased and operated it until about 1910.

Anderson & King built a saltery on Cholmondeley Sound, Prince of Wales Island, in the nineties. In 1904 it was operated under the name of A. E. King. After Mr. King's death his widow operated it from 1906 to 1909. In 1910 the saltery was purchased by C. A. Burckhardt & Co., who built a cannery on the site and began operations in 1911. In 1912 the name was changed to the Alaska Pacific Fisheries.

In 1889 D. Blauw, of Tacoma, Wash., built a saltery on Grouse Island, Boca de Quadra, and dry-salted chum salmon. He operated only one season.

About 1890 a saltery was established on the north shore of the mouth of Quadra Stream, on Boca de Quadra, by Clark & Martin. It was operated intermittently until about 1898, when it was abandoned. The same parties also established a saltery at Ketchikan shortly after the one on Quadra Stream was built and operated this until about 1898, when the plant was turned into a steamer wharf and warehouse for the new town of Ketchikan which was building up around it.

In 1897 a saltery was built on Taku Point, near the head of Taku Inlet. In 1898 and 1899 it was operated by the Quadra Packing Co. In 1900 the Icy Straits Packing Co. operated it.

In 1897 a small saltery was in operation by Cyrus Orr at Point Barrie, Kupreanof Island. In the same year Walter Kosmikoff operated a small saltery at Shipley Bay, on Prince of Wales Island. In 1900 he sold it to the Icy Straits Packing Co.

Fred Brockman in 1897 built and operated a small saltery on Sarkar Stream, Prince of Wales Island. Mr. Brockman operated this saltery intermittently until his death in 1915.

In 1897 Banter & West were operating a saltery at Sukkwan, on Sukkwan Island. In the same year Miller & Co. started another saltery on Kassook Inlet, on Sukkwan Island, while Thomas McCauley was operating a saltery on Whale Passage.

In 1900 the Great Northern Fish Co. operated a floating saltery. Its principal business was salting chum salmon for the Japanese trade, and it operated only one season. J. E. Rice, of Whatcom, Wash., in the same year packed chum salmon on Karta Bay for the same trade.

In 1901 the Muir Glacier Packing Co. put up a saltery on Ideal Cove, Dry Pass, near Wrangell. It has operated mainly as a mild-cure station. It was closed down in 1903, but was opened in 1904. It was then closed in 1905, 1906, and 1907. It was opened in 1908 by K. J. Johansen and operated in 1908 and 1909.

The Seattle-Scandinavian Fish Co. built a saltery on Snug Harbor, Tenakee Inlet, Chichagof Island, in 1902 and made a pack. It packed in 1903 also, but shut down in 1904. The plant was leased in 1905 and then shut down for good.

The Alaska Fish & Mining Co. built and operated a saltery at Revilla, on Tongass Narrows, during the single season of 1902, while the Rice Fisheries Co., in the same year, built and operated a saltery on Boca de Quadra.

The United Fish Co., of Seattle, salted at Tolstoi Bay on the east side of Prince of Wales Island, 1903 and 1904.

The Alaska Fish & Development Co. built a saltery on Pleasant Bay, Admiralty Island, in 1903, and operated it from 1903 to 1905. In 1907 it was operated by the Alaska-American Fish Co., but has been closed since.

Of recent years there have been but few new salteries started in this section, while some of the old plants have been transformed into canneries.

PRINCE WILLIAM SOUND AND COPPER RIVER

The great indentation known as Prince William Sound, and the Copper River delta, a short distance south of the sound, were not exploited as much as many other portions of Alaska until about 1915, due largely to the limited means of transportation and the consequent heavy expense of operation.

The principal source of salmon supply is the Copper River, a glacial stream about 300 miles long, which empties into the Gulf of Alaska through a delta nearly 40 miles in width and extending upstream about 25 miles.

Owing to the constantly shifting shoals in the delta, special knowledge is needed in navigating them, while special flat-bottomed vessels are required as run boats. The gill net and dip net are the only important apparatus in use in the river. In Prince William Sound traps and purse seines catch most of the salmon.

In 1889 a company known as the Central Alaska Co. built a cannery on Wingham, or Little Kayak Island, about 15 miles west from Cape Suckling. It made a pack that year, and the following spring was moved to Thin Point, on the southern side of the Alaska Peninsula.

The Peninsula Trading & Fishing Co. built a cannery on the same island in 1889. In 1891 it was moved to one of the sloughs of the Copper River delta, known as Coquenhena, and operated in 1891. It was closed in 1892 and 1893. The Pacific Steam Whaling Co. operated it until 1897, when it was abandoned.

In 1916 the Hoonah Packing Co. built and operated a cannery on Bering River.

Louis Sloss & Co., of San Francisco, built a cannery under the title of Pacific Packing Co. in 1889 at the extreme eastern end of the sound, close by the present site of Cordova, and called it Odiak. The cannery was closed in 1892. In 1893 it joined the Alaska Packers Association and was operated each season until 1905. In 1906 the buildings and site were sold to the Copper River & Northwestern Railroad Co., which was preparing to build a railroad from Odiak to the headwaters of the Copper River.

In 1889 the Pacific Steam Whaling Co. built a cannery close by the Odiak plant, but in the spring of 1895 it was moved to the spot now known as Orca, about 3 miles north of Cordova. It was closed in 1892, and has been operated ever since except in 1919 and 1920. In 1901 it was taken into the Pacific Packing & Navigation Co. combination. When the latter's assets were sold in 1904, this cannery was not included in the sale, as at the time the plant was under lease to Capt. Omar J. Humphrey. In 1905 it was sold to the Northwestern Fisheries Co., which had purchased most of the Alaska plants of the defunct company, and they have operated it nearly every season since.

In 1915 the Copper River Packing Co. built a cannery on the Copper River at Mile 55, and made a pack the same year. The cannery uses no run boats, but has an arrangement with the Copper River & Northwestern Railroad Co. to haul the fish from the fishing stations to the cannery, and bring the finished product to Cordova for shipment by steamer. In 1918 the name was changed to the Abercrombie Packing Co. The plant was abandoned in 1920.

The Canoe Pass Packing Co., which had built a cannery at Canoe Pass, southeast Alaska, in 1912, and had not operated it subsequently, in 1915 moved the machinery to Cordova and installed it in a rented building and made a pack. It built its own cannery at Shepard Point, near Cordova, in 1917.

In 1916 the Carlisle Packing Co. built a cannery at Cordova, while the Clark-Graham Co. built one at Eyak, a few miles away.

In 1917 the following new canneries were operated: Valdez Packing Co., Valdez; Copper River Packing Co., Port Nellie Juan; Lighthouse Canning Co. and Moore Packing Co., Cordova; and San Juan Fishing & Packing Co., Seward. The latter plant was also equipped for freezing salmon and other fishes. The Lighthouse Canning Co. was canning clams in 1916, the first year of its operation. The Alaska Sea Food Co. took over the Turner cannery, which had been built in 1916 and used in packing clams. The plant was destroyed by fire on

April 4, but was rebuilt the same year, although not operated with salmon until 1918.

A number of salmon salteries were started in Prince William Sound after 1915. Charles Matthews in 1916 operated a salmon saltery at Seward; The Kenai Fishing & Trading Co. in 1916 acquired the J. Bettles saltery on Eshamy Bay. In 1918 the company expanded into a canning plant. A. C. Hoodenpyle operated a saltery at Port Wells in 1918.

In 1919 the following new canneries were started: Franklin Packing Co., Port Ashton; and Pioneer Packing Co., Cordova (this plant had been operating on clams for a couple of seasons). The Eyak River Packing Co. took over the Clark-Graham Co., while the Hillery-Scott Co. succeeded the Lighthouse Canning Co.

The World War led to a considerable expansion in the number of canneries started in this section after 1919. The temporary collapse in demand for canned salmon shortly after the close of the 1920 season had a disastrous effect upon the weakly financed companies, with the result that a number of them failed. As time went on the industry readjusted itself, but, as is the case in southeast Alaska, the region is overmanned with canneries, and the best thing that could happen would be a material decrease in the number at present operating and ready to operate.

COOK INLET

While this great inlet has an abundant supply of salmon, it is one of the most difficult sections in all Alaska in which to fish successfully. The tides and currents in the inlet are strong and treacherous, increasing in height and force as its head is approached, where the tide comes in with a bore which is extremely dangerous to small craft. Shoals make out a long distance from shore and are continually changing.

The first cannery to be built on the inlet was in 1882, when the Alaska Packing Co., of San Francisco, built one at Kasilof, on the right bank of the Kasilof River at the mouth, utilizing the available machinery from the cannery built by the Cutting Packing Co. at old Sitka in 1878. In 1885 this cannery was sold to the Arctic Fishing Co. In 1890 the loss of its cannery ship forced it to close that season. In 1893 it joined the Alaska Packers Association. At the height of the season of 1905 the plant was burned. It was rebuilt the next spring and has been operated each year since with the exception of 1924–1926 and 1928.

The cannery of the Northern Packing Co. was built in 1888 on the eastern side of Cook Inlet, at Kenai, at the mouth of the Kenai River. It was operated up to and including 1891. In 1893 it joined the Alaska Packers Association, but has not been operated since 1891.

In 1897 the Pacific Steam Whaling Co. built a cannery at Kenai, but did not install the machinery and operate it until the next year. In 1901 this cannery was taken over by the Pacific Packing & Navigation Co. In 1903 the plant burned down. Upon the sale of its assets in 1905 the site passed to the Northwestern Fisheries Co. In 1910 the company put up a new plant here and has operated it continuously since, except in 1921 and 1922. During the period when the site was unused a mild-curing establishment was operated here by the San Juan Fishing & Packing Co. in 1907 and 1908. This plant burned down just before the fishing season of 1916 began but was rebuilt in time to operate in 1917 and in the seasons since.

In 1890 George W. Hume, of San Francisco, built a cannery at Kasilof, on the right bank of the river, about half a mile above its mouth. It was operated in 1890, 1891, and 1892. In 1893 it joined the Alaska Packers Association and was consolidated with the plant of the Arctic Fishing Co.

C. D. Ladd operated a saltery on the left bank and at the mouth of the Chulitna River, about 6 miles above Tyonek. This saltery was purchased by the Alaska Salmon Association in 1899. The following spring it erected a cannery here and made a small pack. It was operated also in 1901 and 1902, and then abandoned.

In 1907 J. A. Herbert & Co. established a saltery at English Bay and operated it until 1910.

In 1911 the Seldovia Salmon Co. built a cannery at Seldovia and operated it until late in 1915, when the company went into the hands of a receiver. In 1916 it was reopened by the Columbia Salmon Co. In 1917 it was bought by the Northwestern Fisheries Co. and operated in this and the succeeding year, but was closed in 1919.

In 1912 the Fidalgo Island Packing Co., which already operated a cannery at Ketchikan, in southeast Alaska, built a cannery at Port Graham, at the lower end of the Kenai Peninsula. A pack was made that year and each year since.

The same year Libby, McNeill & Libby built a cannery at Kenai and operated that year and each subsequent year.

In 1915 the Deep Sea Salmon Co., which operates a cannery in southeast Alaska, built a plant near Knik, on the west side of Cook Inlet, and made a small pack. This plant was abandoned at the end of 1917 and part of the equipment sold to a new plant in southeast Alaska.

During the last 10 years a number of small canneries have been started in Cook Inlet and have met with indifferent success. Like most of the other sections, the region has been overfished.

Of recent years considerable salting of salmon has been carried on in Cook Inlet. In 1916 Dr. Knut A. Kyvig, of Anchorage, did some salting at Swanson Creek, Turnagain Arm, under the name of the Kyvig Packing Co. In 1917 the Beluga Whaling Co. salted salmon at Beluga. In 1918 Dr. Kyvig disposed of his interest in the Kachemak Bay plant to the Kachemak Canning Co. Several plants have been started and operated intermittently since.

AFOGNAK ISLAND

Afognak Island lies to the northwest of Kodiak, and it is separated from it by a narrow strait.

In 1889 the Royal Packing Co. built a cannery at the head of Afognak Bay and operated it in 1889 and 1890. It became a member of the Alaska Packers Association in 1893. It has not been operated since 1892.

The Russian-American Packing Co. in 1889 built a cannery immediately above that of the Royal. It was operated in 1889 and 1890. In 1893 it became a member of the Alaska Packers Association. It has not been operated since 1890.

In accordance with an act of Congress approved March 3, 1891, the President, by proclamation of December 24, 1892, set aside the whole island and within 1 mile from the shores thereof as a fish-cultural reserve for the use of the United States Commission of Fish and Fisheries. As a result of this action both canneries were forced to move from the island entirely.

From this time on salmon fishing was restricted to natives, who were permitted to dispose of their catch to canneries and salteries located outside of the reserve.

KODIAK ISLAND

This island has been the scene of some of the best fishing in Alaska. The Russians early settled here, one of the most fertile spots in the usually sterile soil of Alaska, and undoubtedly they must have prosecuted the fisheries from an early date, although but little data are extant showing their operations in this line.

Karluk River and Lagoon.—One of the greatest salmon streams in the world is the Karluk River, and although its importance is much diminished now through long-continued and heavy fishing, it still produces annually a large pack of canned salmon, and has the distinction of having produced more salmon than any other river in Alaska.

It will doubtless surprise most readers to hear that the river which has yielded so many countless thousands of salmon is only 16½ miles in length. It has its source in two lakes, the larger of which is about 8, the smaller, 3 miles long. The mouth of the river is about 2 miles above the canneries, and spreads out here into a lagoon. This lagoon has at the head a width of about 300 yards, and gradually widens until it is nearly half a mile across as it approaches the spit. The lagoon has a general east and west direction, is about 2 miles in length, and, except for the shingle spit which is thrown across its mouth by the action of the sea, its shores are bluff, rising from about 50 to 100 feet. The spit is three-fourths of a mile long with an average width of about 200 feet. The outlet of the lagoon is only 90 feet wide at its mouth. The western side of the mouth of the lagoon is Karluk Head, a precipitous mountain mass about 1,600 feet high.

The outer side of the spit is where the fishing is carried on. Haul seines are used exclusively. As bowlders used to be common here it was necessary to remove a number of them in the early days when a seine shore was to be prepared. The red salmon run here is an exceptionally long one, the season extending from about the middle of June to about the middle of September. The other species of salmon also run here; sometimes humpbacks appear in large numbers. As the beach is open to Shelikof Strait, in which storms are frequent, seining is often interrupted.

As early as 1867 the salting of salmon was carried on at Karluk. In 1870 the Alaska Fur Trading Co. and the Alaska Commercial Co. began to salt salmon and continued this on a gradually expanding scale.

In 1882 Smith & Hirsch, who had been engaged in salting on Karluk Spit, built the first cannery on Kodiak Island. After operating it until 1884 it was organized under the title of the Karluk Packing Co., and packed under that name every year until 1911, when canning operations were transferred to the new cannery in Larsen Bay. In 1893 it joined the Alaska Packers Association.

The Kodiak Packing Co. in 1888 built a cannery on the eastern side of the spit and operated it in 1888, 1889, 1890, 1891, and 1893. It joined the Alaska Packers Association in 1893, but has not been operated since that season.

The Hume Packing Co. built a cannery on the spit about 400 yards westward of Kodiak cannery in 1889. In 1892 it was consolidated with the Aleutian Islands Fishing & Mining Co., which had built a cannery about 100 yards westward of the Hume cannery in 1888. In 1893 the consolidation became a member of the Alaska Packers Association. This plant was not operated in 1900.

In 1888 the Alaska Improvement Co. built a cannery on the left bank of the outlet, opposite the point of the spit and facing the Shelikof Strait. It was ready to pack in 1888, but was not operated on account of the loss of its cannery ship, the *Julia Ford*. In the spring of 1897 it was sold to the Alaska Packers Association and has since been operated by that company.

In 1893 the Hume Canning & Trading Co. built a cannery on the beach under Karluk Head, about three-fourths of a mile northward of the Alaska Improvement Co., in what is known locally as Tanglefoot Bay. It was operated in 1893 and 1894, and in 1895 it was sold to the Alaska Packers Association and operated by that company. It has been closed since.

The great increase in the number of canneries in Alaska in 1888 and 1889 caused such an enlargement of the pack that the markets became glutted, and it was soon apparent that steps would have to be taken to reduce the output if the operators were to avoid bankruptcy.

Captain Moser in "Salmon and Salmon Fisheries of Alaska" [20] thus describes the attempts of the canners to find a working solution of this important problem and the final result of their endeavors:

> In 1890 the three canneries at Chignik combined under an operating agreement known as the Chignik Bay Combination, under which the plant of the Chignik Bay Co. was operated, the three canneries sharing the expense and dividing the output equally. This arrangement remained in force during the seasons of 1890 and 1891. Its evident success in 1890 probably led to the local combinations on Kodiak Island in 1891, and then to the association which now exists.
>
> The large packs during this period and the glutted market caused the cannery interests to devise some scheme to meet the conditions. The combination at Chignik in 1890 permitted the pack to be made there at a lower rate and, as previously stated, it was continued in 1891. The same year (1891) the canneries at Karluk, Uyak, and Afognak entered a combination, under the name of the Karluk River Fisheries, under which it was agreed that each cannery should have a quota of fish from the several localities, based upon the average packs of each cannery in 1889 and 1890. The estimated pack for the canneries interested was placed at 250,000 cases, and upon this estimate the apportionment of the work at each cannery was made. Under this agreement four of the eight canneries were closed, their quota being packed in the other four canneries as follows, viz, that of the Royal at the Karluk, of the Arctic at the Kodiak, of the Aleutian Islands at the Hume, and of the Russian-American at the Alaska Improvement.
>
> In the summer of 1891 the Kodiak Packing Co. and the Arctic Packing Co., both at Alitak Bay, also had a mutual agreement under which only one cannery, the Arctic, was operated, the quota of fish of the Kodiak being packed in the

[20] The Salmon and Salmon Fisheries of Alaska. Report of the Operations of the U. S. Fish Commission, Steamer *Albatross* for the year ended June 30, 1898. By Jefferson F. Moser. Bulletin, U. S. Fish Commission, 1898. Vol. XVIII, pp. 18–21. Washington, 1899.

Arctic cannery. By these combinations the full pack of the Karluk district was made in half the number of canneries and the expense of packing very considerably reduced.

In September, 1891, the Alaska Packers Association was formed to dispose of the unsold salmon of that season's pack (some 363,000 cases) and five trustees were appointed to manage the business. This association was not incorporated and expired after the salmon were sold.

The successful operation of these arrangements led, in 1892, to an arrangement in which nearly all (31) of the canneries joined, entering under the name of the Alaska Packing (not Packers) Association, for the purpose of leasing and operating and therefore controlling the canneries and reducing the Alaska pack for that year, it being found too great for the market's demands. All the canneries in operating condition in 1892 were members of this association except the following: Metlakahtla Industrial Co., at Metlakahtla; Boston Fishing & Trading Co., at Yes Bay; Baranoff Packing Co., at Redfish Bay; Chilkat Canning Co., at Pyramid Harbor; Alaska Improvement Co., at Karluk; and the Bering Sea Packing Co., at Ugashik.

The association was regularly incorporated on January 13, 1892, and shares were distributed on the basis of 1 for each 2,000 cases packed in 1891, and the profits were divided equally on all shares, regardless of the amount of profits derived at the different points. Of the 31 canneries, 9 were operated by the association, while the others were closed, the Alaska pack being reduced one-half.

The year 1893 found the Alaska Packers Association organized and incorporated February 9. This association was formed from the canneries that had joined the Alaska Packing Association of 1892, except the Pacific Steam Whaling Co., at Prince William Sound, and the Peninsula Trading & Fishing Co., the latter's cannery having been moved from Little Kayak Island to the Copper River delta in 1891.

The agreement of 1893 was similar to that of 1892, except that the amount of profit was taken into consideration in addition to the probable average quantity which could be packed at the different points. This was subject to adjustment for each district, and no arbitrary rule was followed. Each cannery entering the association was obliged to purchase an additional amount of stock, equaling two-thirds of the number of shares received by it for its plant; that is, a company which received 1,500 shares for its plant was required to purchase 1,000 shares additional. The money received from this sale of extra stock was used as working capital. No shares were sold to the general public, the owners of canneries subscribing for the full amount.

This association was then and is now (1928) the largest operator in Alaska, and, with its one operating cannery on Puget Sound, is also a factor in that region.

At a number of its canneries the association has always maintained physicians, whose services and supplies have been free to its own employees and to all natives applying for medical advice and medicines. This service has been of incalculable benefit to the latter, a large proportion of whom suffer from disease in some form or other. A number of the other canneries also have doctors at their plants.

No canning has been done at Karluk since 1911, when a new cannery was built at Larsen Bay, a branch of Uyak Bay, and the equipment remaining in the plants on the spit removed to it. This was done because frequent storms had caused havoc to vessels anchored in the open straits opposite the mouth of the lagoon. Since then fishing has been carried on as usual, the fish being carried to the canneries on Uyak Bay. The Alaska Packers Association and Northwestern Fisheries Co.—the oldest operators there—have an agreement to divide the fish on the basis of seven to the former for every three given to the latter.

Numerous attempts have been made of recent years by other operators to participate in fishing operations off Karluk Spit with varying success. As the two companies named above own the greater part of the adjacent beach, where beach seines have to be drawn in order to land the fish, while frequent storms badly hamper the operations of purse seines, other operators have been unable to accomplish much; and this is no more than right, as the original operators were put to much expense to clear the beach and adjacent bottom area for seine hauling. The decrease in the number of salmon entering Karluk of recent years has led the Government to discourage an expansion of operations here.

Alitak Bay.—Alitak Bay, or the "South End", as it is termed locally, is a deep indentation, with several arms, on the southwestern end of Kodiak Island, about 65 miles from Karluk. The seine and trap are the principal apparatus used here.

In 1889 the Arctic Packing Co. built a cannery in the southwest bight of Olga Bay, which is a branch of Alitak Bay and is connected with it by a long, narrow passage. In 1893 it entered the Alaska Packers Association.

In 1889 the Kodiak Packing Co. built a cannery at Snug Harbor, a cove in the passage connecting Olga Bay with Alitak Bay, and operated it in 1889 and 1890. Its quota of fish was packed by the Arctic Packing Co. in 1891. In 1893 it joined the Alaska Packers Association and the same year was dismantled.

In 1918 the Alitak Packing Co. built a cannery on Alitak Bay.

Uyak Bay.—Uyak Bay is on the northwestern side about the middle of Kodiak Island and is a considerable body of water with ramifying arms. On the western shore, near the entrance and about 18 miles from Karluk, is Uyak Anchorage. The harbor is formed by the main shore of the island and Bear and Harvester Islands, and is frequently used as an anchorage by cannery ships and the steamers from Karluk during bad weather. As there are no red salmon streams in Uyak, fishing is carried on elsewhere. Most of it is at Karluk Spit.

In the spring of 1897 the Pacific Steam Whaling Co. and Hume Bros. & Hume built canneries on the main shores at Uyak Anchorage. In 1901 both plants became a part of the Pacific Packing & Navigation Co. and were operated by it. In 1905 the Uyak plants were purchased by the Northwestern Fisheries Co., and the same year one of the plants was destroyed by fire and was not rebuilt. The remaining plant has been operated each year since, except in 1927.

Five miles southeast from Uyak Anchorage is a narrow arm called Larsen Bay. It is 4 miles long. Immediately within the entrance on the northern shore is the site of the cannery of the Arctic Packing Co., which was built in 1888, and operated in that year and 1889 and 1890, since which date it has been closed. In 1893 it became a part of the Alaska Packers Association and in 1896 it was dismantled.

As the association had lost several ships while loading at Karluk, it finally decided to move its plants from that place, and in 1911 a cannery was built at the old site on Larsen Bay, and from that time all cannery operations formerly carried on at Karluk have been performed at this plant.

Uganik Bay.—This bay is next to the eastward of Uyak. For several years a saltery was operated here by Oliver Smith, who sold it to the Alaska Packers Association in 1896. The same year the latter built a cannery on the bay. It made a pack in 1896 and a partial pack in 1897. This cannery was abandoned in 1900.

During the past 12 years various shore and floating canneries have been built and operated for varying periods at other places around Kodiak Island, especially along Karluk Straits.

Kodiak.—Salting operations have been carried on at this old Russian settlement for a number of years.

In order to furnish work for the natives, the Alaska Commercial Co. and Blodgett & Blinn salted the catches made by them in 1906 and subsequent years until 1912, when the Kodiak Fisheries built a cannery and has operated it each year since.

The Woman's American Baptist Home Missionary Society had carried on a home and school for native children on Wood Island, close to Kodiak, for some years. In 1902 the society established a salmon saltery here in order to furnish employment for the natives. No data are recorded in the official reports of further activities on the part of this plant.

CHIGNIK BAY

Chignik Bay is on the southern side of the Alaska Peninsula and is the first important indentation after leaving Cook Inlet on the way to the westward. The bay is about 150 miles southwest of Karluk. On the westward side of the bay is a small deep bay known as Anchorage Bay. Several of the canneries are located here, and the transporting vessels of all the canneries make their anchorage at this point. In the extreme southwest corner of Chignik Bay is the entrance to Chignik Lagoon. At the head of this lagoon, from which all the canneries draw their supplies of red salmon, is the mouth of the stream up which go the schools.

Chignik River is about 6 miles long, with an average width of 100 yards, and its depth is such that a boat can ascend only at high water. It has its rise in two lakes, each about 10 miles long.

Red salmon predominate in the runs, although all five species are to be found. A run of very small red salmon, weighing about 2 pounds, and known as Arctic salmon, appears here every year.

Practically all of the fishing here is with traps, although gill nets and seines have also been used at times.

This bay, next to Karluk Spit, has been the scene of more bitter fights for supremacy in canning than any other place in Alaska.

In 1888 the Fishermen's Packing Co., of Astoria, Oreg., sent a party to Chignik Bay to prospect for fish, and they returned in the fall with 2,160 barrels of salt salmon.

The next year, this company, operating under the name of the Chignik Bay Co., built a cannery on the eastern shore of the Lagoon, 2½ miles from the entrance.

The same year the Shumagin Packing Co., composed of capitalists from Portland, Oreg., and the Chignik Bay Packing Co., of San Francisco, built and operated canneries close to that of the Chignik Bay Co. All three of these companies soon arrived at a working agreement and finally combined into one organization. All were operated in 1889, 1890, and 1891. In 1892 they all joined the pool of the Alaska Packing Association, and the cannery of the Chignik Bay Co. alone operated. In 1893 they all became members of the Alaska Packers Association.

Since 1891 only the cannery of the Chignik Bay Co. has been operated. The Shumagin building has been moved alongside the former and the machinery consolidated, so as to form practically one large cannery.

In the spring of 1896 Hume Bros. & Hume built a cannery on the eastern side of Anchorage Bay and made a pack that year and in 1897.

The same spring the Pacific Steam Whaling Co. built a cannery one-fourth of a mile south of the Hume cannery, and made a pack that year and in 1897. In 1901 this plant, also that of Hume Bros. & Hume, became part of the Pacific Packing & Navigation Co. The failure of this company in 1904 threw its properties onto the market and most of them, including the two Chignik canneries, were purchased by the Northwestern Fisheries Co., which in 1905 shut down the Hume Bros. & Hume plant for good and has operated the other plant ever since.

In 1910 the Columbia River Packers Association built and operated a cannery on Anchorage Bay, and has operated it every year since.

The three companies operating here have an amicable agreement under which they each operate the same number of traps and divide equally the salmon caught.

ALASKA PENINSULA, SOUTH SIDE

Orzenoy.—In 1889 a cannery, under the title of the Western Alaska Packing Co., was built at Orzenoy, on the western side of Stepovak Bay, south side of the Alaska Peninsula. It packed that year and in 1890, but the fish were so scarce that the cannery was dismantled in 1891 and the site abandoned.

Nothing was done with it for some years, but about 1905 Bostrop Omundsen located there and established a saltery. In the winter of 1912–13 August Lindquist purchased a half interest in the plant and it was operated under their joint names until the death of the senior partner in the fall of 1915; since then it has been operated by Lindquist alone.

Thin Point.—Thin Point is on the southern side of the Alaska Peninsula, near its extreme western end. A saltery was operated here for several years, until the Thin Point Packing Co. was organized by Louis Sloss & Co., of San Francisco, and the cannery was built in 1889. It was operated in 1889, 1890, and 1891, and was closed after that date. In 1890 the cannery ship *Oneida*, en route for this place, struck on the Sannaks in April and nearly all of the 77 Chinese on board were lost. In 1893 the plant became a member of the Alaska Packers Association. In 1894 the cannery was moved to the Naknek River, in Bering Sea, and became a part of the cannery of the Arctic Packing Co.

The Alaska Packers Association operated a saltery at Thin Point in 1894, 1895, and 1896, and then abandoned the place.

The cannery of the Central Alaska Co. was moved in 1890 from Little Kayak Island, near Katalla, to Thin Point. It operated during 1890 and 1891, was closed in 1892, and in 1893 joined the Alaska Packers Association, but was no longer operated. In 1895 the available machinery was moved to Koggiung, on the Kvichak River, in Bering Sea.

In 1908 Osmund & Andersen established a saltery at Thin Point and operated it in 1908, 1909, and 1910.

In 1911 the Pacific American Fisheries built a cannery at King Cove, on the south side of the Alaska Peninsula, a few miles east of Thin Point, and in the fall purchased the saltery. The cannery was operated in 1911 and each year since.

In 1917 the Pacific American Fisheries built and operated a new cannery at Ikatan, on Isanotski Strait, at the eastern end of Unimak Island. The Sockeye Salmon Co. built and operated in the same year a new cannery on Morzhovoi Bay, a few miles from the strait, and on the Alaska Peninsula. In 1920 the latter was moved to the Unimak Island side of the strait, and in 1921 sold to P. E. Harris & Co.

SHUMAGIN AND SANNAK ISLANDS

Small salteries have been operated at different places on the Shumagin and Sannak groups. The plants have usually been crude and primitive affairs and were operated whenever the price of salted salmon was high enough to justify same. As the ownership and the location in many instances changed frequently, no attempt has been made even to list them.

In 1920 the Shumagin Packing Co. installed the necessary machinery in its saltery and put up a pack of canned salmon.

BERING SEA

Bristol Bay.—The great redfish producing section of the world is in the Bristol Bay portion of Bering Sea. This bay lies in the eastern section of Bering Sea, inside of a line drawn from Port Moller to Cape Newenham, and a number of important rivers debouch into it, in all of which the annual runs of salmon, especially reds, are important.

Bristol Bay is considerably off the line of steamship travel, and as a result the companies operating here are compelled to have ships in which to bring up their employees and supplies in the spring and to take back the men and prepared products in the late summer or early fall when the season has ended.

Cannery ships belonging to the Nushagak plants are taken into the bay and anchored as near the canneries as possible. Owing to shoals this can not be done on Kvichak Bay and the Naknek and Egegik Rivers. In the early days of the fisheries the ships running to the latter canneries were brought as close to the plants as possible, unloaded by means of scows, and then taken to the Nushagak for shelter. When their numbers were too great to permit of this they were moored in the open about 5 miles off the point separating Kvichak Bay and Naknek River, where the anchorage is good and the vessels have very little trouble in riding out storms. Usually the captain and a boy are left aboard the ship.

NUSHAGAK RIVER AND BAY

The Nushagak River, sometimes called the Tahlekuk, with its tributaries, and the Wood River, which enters the head of Nushagak Bay close by the mouth of the Nushagak, form a favorite resort of the red salmon, while all other species also ascend them.

But little is known of the upper courses of the Nushagak River, except that they drain the region between Lakes Clark and Iliamna on the east and the Kuskokwim on the West.

The river is said to be 200 miles long to the first lake, a large one. Beyond this lake there are three other smaller lakes, all connected by short stretches of river. The largest tributary of the river is the Malchatna, which enters it about 100 miles from the mouth. There are also several small tributaries, two of these being Tikchik River and Portage Creek. There are three or four Indian villages on the Nushagak, Kaknak being the largest. A launch drawing 3 to 3½ feet of water can navigate about 120 miles from the mouth. It is necessary to use a "bidarka" to go into the upper reaches. There are four rapids, around which a portage must be made in each case.

The river on its lower course is large, and flows a great quantity of water into the head of Nushagak Bay.

Wood River is about 24 miles long from its mouth to the first lake. Shoals and bars are frequent in the river, the depth of these at low water being 2½ feet and at high water 4 feet.

Aleknagik Lake, the first of the chain of three, is about 24 miles long, and has an average width of about 2 miles.

An interesting counting experiment was carried on by the Bureau of Fisheries at Wood River. This very important work was first taken up in 1908, as an indirect result of the order closing Wood and Nushagak Rivers to the commercial fishermen, as noted below, and was continued, with the exception of 1914, until the close of the 1919 season. This work was made possible in early years by the generosity of the Alaskan Packers Association of San Francisco and the Alaska-Portland Packers Association of Portland, Oreg., who furnished the material and erected the barricade, also the labor needed throughout the season, while the Bureau of Fisheries furnished the personnel required to carry on the direct work of counting the fish and making other observations. Later everything was furnished by the bureau.

A rack or trap was constructed across the foot of Lake Aleknagik, at a constriction in the lake contour something more than 200 yards wide, for the purpose of intercepting all salmon entering the lake and passing them through gates or tunnels at such a rate and in such a manner that an accurate estimate of their numbers could be obtained. The pot of the trap was located near the left bank, and this had three gates by which the salmon could be passed from the pot into the lake. Each gate was 2 feet in width, and its bottom rested on a wooden platform covered with white oilcloth, so that the fish could readily be seen as they passed over it when the gate was raised. When fish were passing through a gate a small wooden frame with a glass center was arranged so it would float on the water, and in order to hold it in position it was fastened to the framework of the gate. This was for the purpose of making the water smooth so the fish could readily be seen even though the surface were disturbed by ripples, etc.

The following table shows for each year from 1908 to 1919, inclusive, the commercial catch of salmon made in Nushagak Bay, the number of fish passing from Wood River into Lake Aleknagik, the total of both, and the percentage of salmon that escaped the fishermen.

Year	Nushagak Bay catch	Wood River tally	Total	Per cent of escape
1908	6, 140, 031	2, 603, 655	8, 740, 686	30. 0
1909	4, 687, 635	893. 244	5, 580, 879	16. 0
1910	4, 384, 755	670, 104	5, 054, 859	13. 2
1911	2, 813, 637	354, 299	3, 167, 936	11. 1
1912	3, 866, 950	325, 264	4, 192. 214	7. 7
1913	5, 236, 008	753, 109	5, 989, 117	12. 5
1914	6, 174. 097	(1)	----------	----------
1915	5, 676, 457	259, 341	5, 935, 798	4. 3
1916	3, 592, 574	551, 959	4, 144, 533	13. 3
1917	5, 679, 818	1, 081, 508	6, 761, 326	15. 9
1918	6, 078, 965	943, 202	7, 022, 167	13. 4
1919	1, 452, 931	145, 114	1, 598, 045	9. 0

1 Work not carried on this year.

Snake River, a tributary of Nushagak Bay, is about 30 miles in length, very crooked, and has its rise in a single lake close by Aleknagik Lake. There is an Indian village on the river just below the lake. Red salmon are abundant in this stream.

Igushik River is about 50 miles in length and enters Nushagak Bay about 4 miles above Nichols Hills. So far as known it has its source in two lakes—Amanka and Ualik. A short distance below the first lake there are rapids and a small falls. The quite large Indian village of Yacherk is located here, and the natives do most of their fishing in the rapids. Peter M. Nelson established a saltery about 10 or 12 miles above its mouth in 1902, and operated it until he sold it to the Alaska Fishermen's Packing Co., who have operated it since. There is a small Indian village close by the saltery.

Nushagak Bay, in which practically all the fishing is carried on, is about 35 miles long and from 5 to 15 miles in width. Sand bars and mud flats, which are visible at low water, occupy the greater part of its area.

The drift gill net is the favorite apparatus in this bay, although a few traps were also used in previous years. The fish begin to run very early here. Kings usually appear about June 5, reds about June 5 to 8, cohos either late in June or early in July, chum salmon about the middle of June, and humpbacks about the same time. The reds do not run in large numbers until late in June.

Considerable fishing was carried on in both the Nushagak and Wood Rivers until in 1908, when, as a result of a hearing held by the Secretary of Commerce and Labor on December 16 and 17, 1907, it was decreed that beginning January 1, 1908, "it is hereby ordered that until further notice Wood River, a tributary of Nushagak Bay, in the district of Alaska, and the region within 500 yards of the mouth of said Wood River be closed to all commercial fishing, and that all commercial fishing be prohibited in Nushagak River proper."

The earliest fishing by whites in the Bristol Bay section was for salting purposes by the trading companies, more particularly the Alaska Commercial Co., which had an important station at Fort Alexander on Nushagak Bay. Petroff, in the census report of 1880, refers to exports from this section of "from 800 to 1,200 barrels of salted salmon per annum from the Nushagak River."

In 1883 the schooner *Neptune* visited the Nushagak on a salting trip. The next year the Arctic Packing Co. erected a cannery here and made a trial pack of 400 cases. This was the first cannery to operate in Bering Sea. It was located close to the Moravian mission.

This cannery eventually became a member of the Alaska Packers Association, and has not been operated for some years.

The second cannery to be built was by an Astoria company, the Alaska Packing Co., and it was erected on the western side near the head of the bay and about 1½ miles below the junction of the Wood and Nushagak Rivers. It has been operated every year to date, being since 1893 a member of the Alaska Packers Association. It is popularly known as the "Scandinavian" cannery.

In 1886 the Bristol Bay Canning Co. was organized by San Francisco parties, and built a cannery on the western shore of Nushagak Bay in a bend about 2 miles below the cannery of the Alaska Packing Co., at a place called Dillingham. It became a member of the Alaska Packers Association in 1893 and was operated each year until 1907. A couple of years later it was dismantled. This plant was popularly known as the "Bradford" cannery.

The Nushagak Canning Co. built a cannery on the eastern shore of Nushagak Bay in 1888, at a place known as Clark Point, 5½ miles below Fort Alexander. This cannery also became a member of the Alaska Packers Association in 1893, but from 1891 to 1901 was not operated, but held in reserve. In the last-named year a large double cannery was built here and put into operation and has been operated nearly every year since.

This company also built and operated a saltery on the Igushik River in 1886. Three years later it was moved to the mouth of the Nushagak. In 1893 C. E. Whitney & Co. purchased an interest in it and by 1899 owned it all. In 1902 the saltery was sold to the Alaska Packers Association, which closed it down.

In 1899 the Pacific Steam Whaling Co. built a cannery and commenced canning on the eastern shore of Nushagak Bay at Fort Alexander, or Nushagak village. This cannery was purchased by the Pacific Packing & Navigation Co. in 1901, and upon the sale of its properties in 1904 became a part of the Northwestern Fisheries Co. It has been operated each year since the latter company acquired it.

The same year the Alaska Fishermen's Packing Co., of Astoria, built a cannery immediately below that of the Pacific Steam Whaling Co., and operated it every year to date, control of the company passing to Libby, McNeill & Libby in 1913.

In 1901 the Columbia River Packers Association, the Alaska-Portland Packers Association, and the Alaska Salmon Co. all built canneries on the Nushagak and have operated them to date, except the last named in 1909, when its supply ship was wrecked, and the Alaska Portland Packers Association plant in 1921. The Alaska Fishermen's Packing Co. also built a saltery here. The latter plant was abandoned in 1904.

In 1903 the North Alaska Salmon Co. operated a new cannery on the Nushagak, a few miles below Clark Point. This was later sold to Libby, McNeill & Libby.

In 1910, on August 10, shortly after the packing season had ended, the plant of the Alaska-Portland Packers Association was completely destroyed by fire. The plant was rebuilt in time to operate the next season.

KVICHAK RIVER AND BAY

The Kvichak River is about 80 miles in length, varies from 100 yards to a mile in width, and discharges a vast quantity of water.

The influence of the tide is felt 30 miles from the mouth. The current is very swift, running in places as much as 7 miles an hour. The upper half of the river is filled with low, grassy islands, the channels in many places being quite narrow. A launch drawing 3 feet of water can reach Lake Iliamna with very little difficulty. In most sections there are over 2 fathoms of water in the channels. The river drains Iliamna Lake, the largest lake in Alaska, which is about 90 miles long and about 30 miles wide, and Lake Clark. There are a number of Indian villages along the shores of the river and lakes.

Practically all of the fishing here is carried on in Kvichak Bay, gill nets being the only form of apparatus in use. As it is not convenient for the fishermen to take the catch to the canneries, large house lighters and scows are moored in convenient places and the fishermen live aboard the former, while the fish are put aboard the latter and taken to the canneries by the run boats. The numerous shoals in the bay seriously impede both fishing and navigation.

The first fishing operations on the Kvichak were in 1894, when the Prosper Fishing & Trading Co. and the Alaska Packers Association each established a saltery and operated that year and in 1895; in 1896 the latter purchased the plant of the former and consolidated the two.

In 1895 the Point Roberts Packing Co., which was owned by the Alaska Packers Association, built a cannery at Koggiung, the site of the former saltery, and operated it the next year.

In 1900 there was a considerable development in this region. The Kvichak Packing Co., owned by the Alaska Packers Association, built a cannery on the northern point of entrance to Bear Slough, while the North Alaska Salmon Co. built two canneries about 1,000 feet apart on the left bank of the Kvichak, about 6 miles above Koggiung.

The latter company built a cannery at Hallerville on the Lockenuck River, a tributary of the Kvichak, in 1904. In 1913 a large new cannery to take the place of the Hallerville plant was built on the lower side of Pedersen Point, lower down on Kvichak Bay. In 1916 all the plants of this company were purchased by Libby, McNeill & Libby and have been operated by that company since.

The second plant of the Alaska Packers Association, known as the Coffee Creek plant, was burned down in 1906. It was rebuilt in 1908 and operated again in 1909 and has been operated continuously ever since.

In 1904 the Union Packing Co. established a cannery on the left bank a little distance above the canneries of the North Alaska Salmon Co., having moved this plant from its original location on Kell Bay, in southeast Alaska. It was operated until 1907, when it was abandoned.

About 1905 the Northwestern Packing Co. built a saltery on the east side of the bay. In 1908 it was sold to and operated by Nelson, Olsen & Co., who in 1910 sold it to the Alaska Fishermen's Packing Co., which the following year turned it into a cannery. In 1913 Libby, McNeill & Libby bought this and the Nushagak plant and continued to operate them under the old name. This cannery was destroyed by fire in the spring of 1915. It was rebuilt and operated in 1916.

In 1922 the Carlisle Packing Co.'s floating plant, which was forced to move from the Yukon River by the closure of that river, began operations here. In 1924 a shore plant was established to replace the floater. This plant was sold to the Alaska Packers Association in 1927.

After Peter M. Nelson sold out his saltery interests in 1910, he crossed to the west side of the bay and established a saltery there. In 1925 this plant was sold to the Nakat Packing Corporation, which replaced it with a cannery and named the location Nakeen.

NAKNEK RIVER

But little is known of the Naknek River for more than 10 or 15 miles from its mouth. It is said that the river is about 60 miles long and has its rise in a lake which is of considerable size. With the exception of a short series of rapids, up which it is possible to haul a boat with a rope from the shore, the river is navigable for small craft. Shoals and banks, many of which uncover at low water, are abundant in the lower courses of the river.

Red salmon is the principal species entering this river, although all the other species are to be found here in lesser abundance. They appear here a little later than in the Nushagak Bay. Only gill nets are used in fishing.

The first commercial fishing on the Naknek River was in 1890, when the Arctic Packing Co. built and operated a saltery on the east bank about 4 miles from the mouth. This plant was sold to the Alaska Packers Association in 1893. The next year the latter built a cannery here, made the first pack in 1895, and has operated the cannery every year since. Ultimately the saltery was merged with the cannery.

In 1901 the association built another cannery about a mile nearer the mouth, and in 1911 still another was built close to the mouth.

In 1890 L. A. Pedersen built and operated a small saltery on the right bank about 3 miles from the mouth. In 1894 the Naknek Packing Co. purchased the saltery and erected a cannery a short distance above. This saltery and another built on the shore of Kvichak Bay in 1897 were operated for some years. In 1907 the latter was turned into a cannery and operated by Mr. Pedersen under the name of the Bristol Bay Packing Co. The Naknek Packing Co. cannery has been operated to date, the operations being taken over by the Red Salmon Canning Co. in 1928.

In 1916 the Red Salmon Canning Co. built and operated a cannery on the river about 2 miles above the plant of the Naknek Packing Co.

In 1918 the Northwestern Fisheries Co. operated a new cannery on the river about 2 miles below the plant of the Naknek Packing Co.

In 1919 the Alaska-Portland Packers Association operated a new cannery on the river several miles above the upper cannery of the Alaska Packers Association. In 1929 this plant and the one operated by the same company on the Nushagak River were sold to the Pacific American Fisheries.

EGEGIK RIVER

According to the natives, this river, which is sometimes called the Egegak, Igagik, or Ugaguk, is about 80 miles long from the mouth to Lake Becharof, at the head. The lake itself is about 45 miles long and

15 miles wide. The river is navigable for small boats to within 10 miles of the lake, whence there is a succession of rapids, around which it is necessary to portage. The lower part of the river has numerous shoals, some of which are exposed at low water. King Salmon River, the principal tributary, enters about 7½ miles from the mouth.

The red salmon is the principal species, although all the other species are found in much lesser abundance. Gill nets alone are used here.

In 1895 the Alaska Packers Association established a fishing station on the right bank about 5 miles from the mouth and operated as a saltery until 1900, when the apparatus was moved to the cannery site.

In 1899 the Alaska Packers Association, under the name of the Egegak Packing Co., commenced building a cannery on the left bank opposite and a little above the salting station. This plant was finished in 1900 and packs were made that year and each succeeding year except 1905 and 1906.

In 1903 the North Alaska Salmon Co. built and operated a cannery on the opposite shore from the Alaska Packers Association and has operated it nearly every year since, of late years under the name of its new owners, Libby, McNeill & Libby.

UGASHIK RIVER

This river has its rise in a chain of two lakes, but with the exception of that portion below the upper cannery, about 25 miles, it is very little known to the whites. The river is very tortuous in its course. It has two known tributaries—King Salmon River, which enters through the left bank about 17 miles from the bar at the mouth, and Dog Salmon River, which enters through the left bank about 37 miles from the bar. From Smoky Point to the capes at the mouth the river widens very greatly, being about 20 miles across at the mouth. Shoals are numerous, but there is a channel with about 9 feet at low water. Gill nets exclusively are used here.

This river is essentially a red salmon stream, but the other species are also taken in small numbers, although the humpback is very scarce.

C. A. Johnson was the first man to operate commercially on this river, having erected a saltery on the left bank, about 23 miles above Smoky Point, in 1889, and operated it continuously from 1889 to 1898, both inclusive. This saltery was merged in the cannery of the Bering Sea Packing Co. In 1894 Mr. Johnson established and operated another saltery on the right bank of the river, about 12 miles from the bar, which he sold in 1899 to the Alaska Packers Association, who absorbed it in their cannery plant.

The Bering Sea Packing Co., a branch of the Alaska Improvement Association, in 1890 built the first cannery on the river, this being located on the left bank near the first Johnson saltery. A small pack was first made in 1891. The plant was closed in 1892 and 1893, and as the location had proven far from suitable, it was, in 1894, moved to a point on the left bank, about 15 miles above Smoky Point, where it was operated until 1896. The next year it was sold to the Alaska Packers Association. The machinery and equipment were utilized in the latter company's cannery, and the old location abandoned.

In 1893, Charles Nelson established a saltery on the left bank of the Ugashik, immediately above the last site of the Bering Sea Packing Co. It was operated in 1893 and 1894, and then sold to the Alaska Packers Association, who closed it down.

In 1893 the Alaska Packers Association also built a saltery on the left bank of the river about a mile below the last site of the Bering Sea Packing Co. It was operated each year until 1895, when it was merged into the association's cannery.

In 1895 the Alaska Packers Association built a cannery, known as the Ugashik Fishing Station, on the right bank of the river immediately above the pilot station, which is about 12 miles from the bar. It made the first pack in 1896 and packed every year until 1907, when it was closed. In 1906 its outfit was destroyed in the San Francisco fire, and it was decided to operate it as a saltery, but the burning down of the Coffee Creek cannery of the association on the Kvichak changed the plans, and a part of the saved outfit of the latter was sent to the Ugashik and the plant operated as a cannery. After being closed down for some years it was rebuilt in 1919 but was not put into operation until 1920, since when it has been operated each year.

The Bristol Packing Co. built a cannery on the left bank of the river about 25 miles from Smoky Point in 1900. A pack was made the same year and the plant operated continuously until 1906, when it was shut down, and a small salting crew operated a portion of the plant. Eventually the plant was dismantled without operating again as a cannery.

In 1901 the Alaska Packers Association built and put into operation another cannery about 15 miles up the river from the other one. In 1906 this plant was shut down and eventually it was dismantled.

In 1901 the Red Salmon Canning Co. also built and operated a cannery still farther up the river and has operated it continuously to date.

In 1922 the International Packing Co. operated the floating cannery *Santa Flavia* here in the early season, and then moved her to Uyak for the late run. In 1924 the floater was operated during the latter part of the season in Makushin Bay, on Unalaska Island. In 1928 the *International* replaced the *Santa Flavia*.

ALASKA PENINSULA, BERING SEA SIDE

Of recent years canneries have been located on the Bering Sea side of the Alaska Peninsula, outside of Bristol Bay proper, but it is probable that their numbers will not be large in the future, as the fisheries tributary to them are not very extensive, and are also very much scattered, making transportation expensive.

Port Heiden.—This important indentation on the Bering Sea side of the Alaska Peninsula, about midway between the Ugashik River and Port Moller, has never figured to any considerable extent in fishing operations. In 1912 and 1913 Gorman & Co. had the schooner *Harriet G.* located here throughout the season, engaged in salting salmon. The Illnik Packing Co. operated a saltery here in 1918.

Port Moller.—This great indentation in the Alaska Peninsula, between Port Heiden and Nelson Lagoon, was neglected for many years for the more profitable Bristol Bay region.

About 1902 the Bering Sea Packing & Trading Co. (there seems to be some confusion between this name and that of the Peninsular Packing Co., the latter being the name the company was known by after the first year or two in the official records), established a saltery on Bear River, which debouches a little east of Port Moller, and operated it until 1906, after which operations were suspended and but little is now left of the plant.

In 1912 the Pacific American Fisheries erected a cannery on Port Moller, but it was not operated until 1913. This concern has been successful mainly because of its introduction of purse seines in fishing.

In 1916 the Bering Sea Packing Co. built and operated a cannery on Herendeen Bay, a branch of Port Moller. In 1917 two new canneries were built and operated here, that is, the Fidalgo Island Packing Co. and the Phoenix Packing Co. In 1918 the Bering Sea Packing Co. was taken over by the Everett Packing Co. In 1919 all three Herendeen Bay canneries, as a result of the exceedingly slight runs of the two previous seasons, combined forces for the season and put up all the fish caught at the plant of the Fidalgo Island Packing Co. This plant was subsequently dismantled. In 1920 the Everett Packing Co. operated its cannery in the interest of the Herendeen Bay consolidated canneries and in 1921 both that and the Phoenix Packing Co. cannery were in operation. Since then only the Everett Packing Co. cannery has been operated each year.

Nelson Lagoon.—Nelson Lagoon is on the Bering Sea side of the Alaska Peninsula, is about 6 miles in length and about 2 miles in width. At its western end debouches the Nelson River, which is about a mile wide at its mouth. About 18 miles from the mouth the river divides, both branches having their rise in lakes. There is an easy portage from the lakes to Pavlof Bay, on the Pacific side of the peninsula, and this route is used frequently by both white men and Indians. The run is mainly of red salmon, and gill nets and traps are utilized. During the last few years purse seines have been used in this region with considerable success.

In 1902 Charles Johnson, who had operated on the Ugashik River, established a saltery here and operated it under the name of the Lagoon Salmon Co., and made a pack that and the succeeding year. In 1904 and 1905 it was shut down. It was reopened in 1906 and continued to operate until it was sold in 1914. In 1915 the new owners, the Nelson Lagoon Packing Co., built a cannery here which was operated until 1920, when it was shut down.

Unalaska Island.—In 1916 the Pacific American Fisheries, having obtained a permit from the Department of Commerce, built a cannery at Unalaska, on Unalaska Island. This cannery is located inside of the Aleutian Islands reserve, and permit was given for its building and operation so that it might be possible for the Indians of Unalaska and Dutch Harbor to obtain work at home and save them the long trip to the Bristol Bay plants. It ceased operations at the end of the 1917 season. Since then only floating canneries have operated here.

KUSKOKWIM RIVER

This, one of the great rivers of Alaska, has been but little exploited as yet. Very little accurate data have been obtainable about the river until within recent years, and this relates mainly to the bay and a few miles of the adjacent river, which the United States Coast and Geodetic Survey has charted.

We know that the river has considerable runs of salmon, but usually ice conditions have been such in the spring that a cannery crew frequently could not get in in time to prepare for the run. In 1906 a salting outfit was sent here by Seattle dealers, but arrived too late for the run of fish. The outfit was cached at Bethel.

During a number of years mild curing of king salmon has been carried on here, but the lack of cold storage, both ashore and on the vessels operating to and from the river, has prevented any considerable development of this industry.

YUKON RIVER

The 1918 report of the Alaska agent of the United States Bureau of Fisheries [21] contains the following account of the development of the salmon fisheries of the Yukon River:

The development of the Yukon salmon fisheries began in 1918 with the establishment of a floating cannery at Andreafski. The season's operations resulted in a pack of 13,463 cases of salmon, divided as follows: Cohos 2,661, chums 6,471, humpbacks 107, and kings 4,224 cases. In addition to this, 10,400 pounds of cohos and chums were dry-salted. The total catch of salmon for the cannery was 115,531, of which 26,144 were cohos, 73,921 chums, 3,227 humpbacks, and 12,239 kings. Fishing was carried on from the mouth of the Yukon to a point above the junction of Clear River, chiefly in that part of the Yukon delta known as Kwikluak Pass. The fishing seasons were as follows: Kings, June 26 to August 17; chums, June 28 to September 8; humpbacks, July 7 to July 29; and cohos, August 3 to September 8. Some of the cannerymen and others frequently refer to salmon of one kind by the name "Yukons" or "Yukon salmon." In so doing they mean bright or fresh-run chums.

An investment of $48,000 was made in the plant. One stern-wheeler, the *Martha Clow* (65 tons net), one gas boat, the *Althea* (17 tons net), and three smaller power boats were operated in connection with the cannery. Salmon were taken with 124 gill nets aggregating 9,869 fathoms, and 6 wheels of the 2-scoop pattern. Employment was given to 169 men, 55 being fishermen, 102 shoresmen, and 12 transporters. Of these, 36 were natives, 13 of whom were listed as fishermen.

Stokes & Stokes operated a small saltery on the lower Yukon, packing 15 barrels of chum salmon. Their plant was valued at $1,500. Equipment consisted of one power boat and 300 fathoms of gill nets. They report having located too far up the river, but before another season will move to a point lower down.

Warden C. F. Townsend reported that one Sepella operated a saltery on the Yukon about 12 miles from salt water and that a pack of 110 barrels of chums and cohos was made. Salmon were taken with gill nets and one wheel. Mr. Townsend also advised that the Delta Fishing Co. was in the field in a small way.

Statistics compiled at the close of the season of 1918 indicate that exclusive of gear operated by the cannery and salteries near the mouth of the river, the whites and natives on the Yukon and tributary waters used 393 fish wheels, valued at $19,650, and 130 gill nets aggregating 3,250 fathoms, valued at $6,500. The estimated catch for local requirements was 1,400,000 salmon, which when dried represented approximately 700 tons of fish, valued at $140,000.

The total population of the Yukon region of Alaska, dependent in some measure on the fisheries, was estimated late in 1918 as being 10,907, of which number 6,638 were whites and 4,269 were natives. The number of dogs in the region was estimated at 6,183.

Prior to the season of 1918 the size of the run of salmon in the Yukon was an almost unknown quantity. The belief was expressed in some quarters that a comparatively small run ascended its waters, but others who were interested in

[21] Alaska Fisheries and Fur Industries in 1918. By Ward T. Bower. Appendix VII, Report, U. S. Commissioner of Fisheries, 1918, pp. 29–30. Washington, 1919.

the commercial exploitation of its fisheries held the opinion that a run aggregating many millions of salmon annually ascended the river. The necessity of maintaining the fisheries is paramount at all times, and if it is reasonable to suppose that a serious depletion of the supply by unrestricted fishing seems imminent, limitations must necessarily be imposed. This was done on December 14, 1918, by the promulgation of regulations affecting commercial fishing for salmon in the Yukon River. The closing order which is published in full on page 11 in this report became effective January 1, 1919.

In 1922 Waechter Bros. located a plant on Leslie's Island, outside the protected zone, and mild-cured and froze salmon for a couple of seasons.

MISCELLANEOUS PLACES

At times small quantities of salted salmon have been packed in Bering Sea in the neighborhood of Nome and St. Michael. In 1917 the Arctic Fish Co. operated on a large scow on Golovin Bay, near Nome.

ARCTIC OCEAN

Although it is known that there are good runs of salmon in some of the rivers debouching into the Arctic, the ice and other conditions have deterred people from attempting to extend their operations into this region. In 1912, however, the Midnight Sun Packing Co. built and operated a small cannery on Kotzebue Sound, in the Arctic Ocean. A small pack, mostly of Dolly Varden trout, was made in that and subsequent years. The plant was not operated in 1919 and was later on abandoned entirely.

BRITISH COLUMBIA [22]

Fraser River.—This, the largest river in British Columbia (over 1,000 miles in length), has been important from a fishery standpoint ever since salmon canning was taken up commercially.

The Hudson Bay Co., the first to prepare salmon for commercial purposes, bought the fish from the Indians and pickled them in barrels for export, mainly to the Hawaiian Islands and Asia.

Howay,[23] in his work on British Columbia, after describing briefly the fishing operations carried on by the Hudson Bay Co. in the Fraser River, has the following to say with respect to the development of the commercial salmon fisheries and the preparation of the catch by salting and canning on the part of the independents who succeeded the company:

SALMON CANNING INDUSTRY

No sketch of our history could be called complete without containing some reference to the origin and development, during the early stages, at any rate, of the industry of salmon canning.

By its charter the Hudson Bay Co. was granted " the fishing of all sorts of fish, whales, sturgeons, and all other royal fishes in the seas, bays, inlets, and rivers, within the premises (that is within the undefined area surrounding Hudson Bay), and the fish taken therein." Though no similar grant was contained in the exclusive license of trade with the Indians west of the Rocky Mountains, which was the only title the company had in this region, yet it claimed and exercised a monopoly of the salmon fishing on the Fraser River.

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[22] The author is indebted to Henry Doyle, of Vancouver, British Columbia, for practically all of the historical data relating to the canning industry of British Columbia, and hereby expresses his deep appreciation for this and many other courtesies.

[23] British Columbia, From the Earliest Times to the Present. By F. W. Howay. 4 vols., illus. Vancouver, 1914.

Reference has already been made to the salmon fishery carried on by the company at San Juan Island. In August, 1829, at Fort Langley (the name of this place has since been changed to Derby) 7,544 salmon were obtained from the natives at a cost of £13 17s. 2d. in goods. The trade increased; in 1835 and for many years thereafter 3,000 or 4,000 barrels of salt salmon were exported, principally to the Hawaiian Islands. With the revocation of the license in 1858 this claim of monopoly fell.

Capt. William Spring, in 1863, began salting and curing salmon at Beechy Bay. In the following year Mr. Annandale, with whom Mr. Alexander Ewen was associated, opened a salmon saltery on Fraser River. This venture was almost a complete failure, owning to the attempt to use the Scotch trap nets instead of drift nets. The former were found utterly unsuited to the conditions on Fraser River. When this enterprise failed, Mr. Ewen introduced drift nets and carried on an extensive business in salted salmon with the Hawaiian Islands and Australia.

The first attempt, on the Fraser River, to preserve salmon in hermetically sealed cans was made in 1867 by James Symes. This was not a commercial effort, but a mere experimental test to ascertain the possibility. A few cases were prepared, filled, and cooked by boiling on an ordinary kitchen stove. The result was most encouraging. The product was shown at the agricultural exhibition held in New Westminster in October, 1867, and was pronounced excellent, the directors making special mention of it.

About the same year Donald McLean established another salmon-curing establishment at New Westminster. Besides salted salmon, he put up pickled salmon, salmon boiled and preserved in vinegar, and smoked and kippered salmon.

The canning of salmon as a business was first undertaken on the Fraser by Alexander Loggie & Co. The persons interested were Alexander Loggie, Alexander Ewen, James Wise, and David S. Hennessy. Mr. Wise was an experienced fisherman; Messrs. Loggie and Hennessy had had experience in the canneries of New Brunswick. In June, 1870, these persons built, in connection with a salmon saltery, the first salmon cannery in British Columbia. It was located at Annieville, about 3 miles below New Westminster. The cannery was a very primitive affair; the cylinders upon which the cans were shaped were of wood covered with sheet iron; the trays were small wooden contrivances holding about three dozen one-pound cans. There was practically no machinery; the operations were almost entirely by hand. The fish after being put into the cans was preserved by boiling in large wooden vats. Great difficulty was experienced in thoroughly cooking the fish, the boiling point of ordinary water not proving sufficient; to overcome this, salt was added to the water, and by this means the temperature was raised to 230°. The room in which the cooking was performed was, in temperature like a Turkish bathroom; no windows or doors were allowed to be opened, except of necessity, under the mistaken idea that the cold currents of air would injure the product.

Captain Stamp, who has been frequently mentioned in the foregoing pages, also entered the business at the same time. His cannery was located at Sapperton, New Westminster. He did not attempt to manufacture his cans, but obtained his supply from Mr. Deas, a tinsmith of Victoria.

About 1873, Loggie & Co. removed their cannery to New Westminster, where in the meantime Messrs. Lane, Pike & Nelson had established themselves in the same business. These latter persons conceived the plan of canning the salmon whole; the sockeyes, being of an almost uniform size, lent themselves readily to this attempt. It was, however, a failure, as owing to the great vacuum in the cans they became much distorted.

In 1872 Holbrook & Co. purchased a small cannery which had been started at Sapperton by Captain Stamp some time before, and operated it for a few years.

In 1876 there were three canneries running, consisting of Holbrook & Co., Ewen & Co., and the British Columbia Canning Co. (Deas Island).

The following year this was increased by English & Co. and Finlayson & Lane, the latter quitting after one season, being succeeded in 1878 by Lane, Pike & Nelson. King & Co., the British Columbia cannery (Annieville), and the Delta cannery also commenced operations the latter year.

In 1879 Holbrook & Co., and Lane, Pike & Nelson dropped out, and Haigh & Sons (succeeded in 1884 by the Bon Accord Packing Co.) commenced operations.

King & Co. were burned out in 1880, and Adair & Co., afterwards known as the Wellington Packing Co., commenced. A year later Laidlaw & Co. commenced operations.

In 1882 the British Union Packing Co., afterwards known as the Harlock Packing Co., commenced packing salmon. The British-American cannery and J. H. Todd & Sons (Richmond cannery) also began operations.

Joseph Spratt started a floating cannery, known as "Spratt's Ark," in 1883; he retired at the end of two years. E. A. Wadhams also began operations in 1883. In 1887 the Holly cannery was built on Lulu Island opposite Deas Island. The high water of June, 1894, partially destroyed it and the site was abandoned.

The Anglo-British Columbia Packing Co. was formed in 1891, taking over the canneries formerly operated by the British Columbia Packing Co. (old Annieville plant), E. A. Wadhams, British-American Packing Co., Canoe Pass Canning Co., Duncan & Batchelor (Britannia cannery), and English & Co. (Phoenix cannery).

Three canneries were started in 1889, 2 in 1892, 6 in 1893, 4 in 1894, 4 in 1895, 7 in 1896, 9 in 1897, but only 1 in 1898. During the period 1899 to 1901, 7 were started.

Like the other canning sections, British Columbia suffered in 1901 from an oversupply of canned salmon, due to the large number of plants which had been erected and which were producing more salmon than market could be found for. At this juncture the British Columbia Packers Association was formed. It embraced 29 out of the 48 plants on the Fraser River and 12 of those situated in Northern British Columbia waters, including the following plants: Ewen & Co., Delta, Harlock, Wellington, Lulu Island, Terra Nova, Pacific Coast, Canadian Pacific, Short & Squair (Imperial cannery), Brunswick canneries at Steveston and Canoe Pass, Dinsmore Island, Sea Island, Fisherman's Packing Co., Reliance cannery, Atlas cannery, Boutiliar & Co., Hume & Co., Anglo-American, Provincial, Westham Island, Westminster Packing Co., Premier, Cleve, Welsh Bros., Currie, McWilliams & Fowler, Colonial, Greenwood, Wurzburg & Co., and the Acme Canning Co. In 1914 the corporation style was changed to the British Columbia Fishing & Packing Co. (Ltd.).

During the period from 1902 to 1918 a number of new canneries were started in this region. The blocking of Hell Gate Canyon in 1913 by a rock slide—together with the dumping of débris from a railroad being built through the canyon, described elsewhere in this report—was a great disaster to the salmon industry. The effects of this disaster, which were not observable until the season four years later, led to a tremendous decrease of the quadrennial big year—in one of which the blockade occurred—and this soon led to a corresponding decrease in the number of canneries operating. In 1928 the number had dropped to four.

In 1928 the British Columbia Packers (Ltd.)—an $8,000,000 corporation—was formed to take over the British Columbia Fishing & Packing Co. (Ltd.) and the Gosse Packing Co. (Ltd.) This gives the new company control of 39 active canneries, 5 reduction plants, and 3 cold-storage plants, making it the largest in British Columbia.

The last few years have witnessed considerable consolidation of plants, mainly through purchase of individually operated plants by companies with large capital. One of the most notable examples is that of the Canadian Fishing Co. (Ltd.) of Vancouver. By purchase of existing plants and the construction of new ones this company now (1928) owns and operates in the various sections of the Province, 17 salmon canneries, 3 salteries, 4 mild-cure stations, 6 cold-storage plants, and 3 reduction plants.

Skeena River.—The first cannery to be built on the Skeena River was in 1877, when a man named Neill built one at Inverness. In 1878 the Windsor Canning Co., consisting of Henry Saunders, W. H. Dempster, and John Wilson, of Victoria, established a cannery at Aberdeen.

There were no additions until in 1883, when the Balmoral cannery, the British-American, and Robert Cunningham canneries were started.

In 1889 the North Pacific was started and in 1890 the Standard. In 1891 the Anglo-British Columbia Packing Co. bought the British-American cannery and the North Pacific Canning Co. cannery. In 1892 the Claxton, and in 1895 the Carlisle, canneries were built. In 1899 the Claxton cannery was purchased by the Wallace Bros. Packing Co. The Peter Herman (afterwards the Skeena River Commercial Co.) and Turnbull canneries were built in 1900. The last named operated only four seasons.

In 1902 the British Columbia Packers Association acquired the Balmoral, Cunningham, and Standard canneries.

In 1903 the Cassiar cannery was built. The next year the Alexandria Packing Co. was started. It was later acquired by the British Columbia Packers Association, as was also the Dominion cannery, which was built in 1906.

In 1911 the Wallace Fisheries (Ltd.) purchased the Claxton cannery from the Wallace Bros. Packing Co., while in 1913 the Canadian Fish & Cold Storage Co. built a cannery at Tucks Inlet, where their supply of salmon is obtained from the Skeena fishermen.

In 1916 the Gosse-Millerd Packing Co. built their Sunnyside plant. In 1918 the Northern British Columbia Fisheries (Ltd.) purchased the Skeena River Commercial Co.'s plant at Port Essington and also erected a new cannery at Port Edward. In 1919 the Maritime Fisheries (Ltd.) built and operated a new plant at Haysport. From this time on, the number of canneries operated fluctuated considerably.

Rivers Inlet.—The first cannery to be built and operated on Rivers Inlet was in 1881 by Shotbolt & Draney, afterwards the British Columbia Canning Co. The Wannuck cannery was built in 1884, the Good Hope in 1895, the Brunswick in 1896, the Wadhams and the Vancouver in 1897.

There were no changes until 1902, when the British Columbia Packers Association acquired the Wadhams, Brunswick, Wannuck, and Vancouver, the two latter being dismantled and the two former enlarged correspondingly.

In 1906 the Beaver cannery was built by J. H. Todd & Sons, the Kildalla cannery by the Kildalla Packing Co., and the Strathcona cannery by Bain & Wilson, the latter afterwards being acquired by the Wallace Fisheries (Ltd.).

In 1911 the Strathcona Packing Co.'s plant was purchased by Wallace Fisheries (Ltd.). In 1917 the Provincial Canning Co. built a plant, and in 1918 the McTavish Canning Co. also built one.

Naas River.—The first cannery to be built on the Naas River was by Henry Croasdale in 1881, and it operated for four years. The Douglas Packing Co. built a cannery here in 1882 and operated it for two years. Both were then shut down owing to the fact that the locations were too far up the river for steamers to move the packs. In 1888 the plants were dismantled and removed to Naas Harbor and Mill Bay, respectively. In 1889 the Cascade Packing Co. commenced operations, but the plant was dismantled in 1893.

In 1903 the Pacific Northern cannery was built near the mouth of Observatory Inlet, and in 1905 it was purchased by John Wallace, who moved it to Arrandale. In the latter year the Port Nelson Canning & Salting Co. started. In 1908 the Mill Bay cannery was purchased by the Kincolith Packing Co. In 1911 the Arrandale and Port Nelson canneries were bought by the Anglo-British Columbia Packing Co., and in the following year the Naas Harbor cannery was bought by the British Columbia Packers Association.

The Wales Island cannery, which became Canadian property under the Alaska boundary award, was in 1911 purchased by M. Desbrisay & Co., by whom it has since been continuously operated.

In 1916 the Kincolith Packing Co.'s Mill Bay plant was purchased by the Kincolith Fisheries (Ltd.), while in 1918 the Northern British Columbia Fisheries (Ltd.) purchased the Mill Bay cannery from the Kincolith Fisheries (Ltd.) and built a new plant at Kumeon. The Western Salmon Packing Co. also built a new plant at Summerville the same year.

Queen Charlotte Islands.—In 1912 the British Columbia Fisheries (Ltd.), a concern promoted by Sir George Doughty, M. P., of Grimsby, England, built a cannery at Aliford Bay, Skidegate Inlet, and operated same for two seasons. The British Columbia Fisheries (Ltd.) then went into insolvency, and the plant remained idle until 1916, when it operated under lease to the Western Salmon Packing Co. In 1917 the cannery was purchased by the Maritime Fisheries (Ltd.), the present owners.

The Wallace Fisheries (Ltd.) built at Naden Harbor in 1912, and operated that and the following seasons. The cannery was not in commission during 1914 or 1915, but ran in the years 1916 to 1918, inclusive. It was found that Masset Inlet would be a more suitable location, and in 1919 the plant removed from Naden Harbor to a new site on the shores of the inlet.

A cannery was built at Lockeport in 1918 by the Lockeport Canning Co. The same year the Western Salmon Packing Co. (Ltd.) built a plant at Lagoon Bay.

Miscellaneous places.—A cannery was built at Metlakatla in 1882 by Rev. John Duncan for the Metlakatla Indians, fish being obtained from Skeena River. The plant was dismantled in 1886.

John Rood built the first cannery on Smiths Inlet, in Quachela Lagoon, in 1883. It was closed in 1884, and the plant moved to Wannuck, Rivers Inlet, to which place also the Smiths Inlet fish were subsequently transported for packing purposes. In 1902 the Wm. Hickey Canning Co. built a new plant on Smiths Inlet, selling same in 1912 to the Wallace Fisheries (Ltd.). The Western Packers (Ltd.) also built at Marguerite Bay in 1917.

A cannery was built at Lowe Inlet in 1890 by the Lowe Inlet Canning Co. It was sold to the British Columbia Packers Association in 1902.

In 1890 a cannery was built at Gardiner Canal by a man named Price and his associates. It ran until 1893, when it was dismantled and closed.

Robert Draney built at Namu in 1893, selling out in 1912 to the Draney Fisheries (Ltd.), who in turn sold out to the Northern British Columbia Fisheries (Ltd.) in 1918.

Robert Draney built the Kimsquit cannery in 1901, and in 1907 the Kildalla Packing Co. built the Manitou cannery. The latter is still operating, but in 1912 the Draney Fisheries (Ltd.) purchased the Kimsquit cannery, and in 1918 sold it again to the Northern British Columbia Fisheries (Ltd.).

In 1900 the Bella Coola cannery was built by John Clayton and sold by him in 1902 to the British Columbia Packers Association, who have operated it ever since. In 1917 a new cannery was built by the Tallheo Fisheries (Ltd.) and sold by them in 1918 to the Northern British Columbia Fisheries (Ltd.).

Toms, Morris & Fraser built at China Hat in 1900 and sold to the British Columbia Packers Association in 1902. The latter dismantled and closed the plant in the fall of that year.

A cannery was built at Warke Island in 1911 by John Wallace, principally for packing Gardiner Canal fish. The plant was purchased in 1917 by the Western Packers (Ltd.).

A cannery was built at Bella Bella in 1912 by the East Bella Bella Canning Co. It was sold in 1915 to the Gosse-Millerd Packing Co., who operated it until December 30, 1923, when it burned.

The cannery built at Alert Bay in 1881 by S. A. Spencer was purchased in 1902 by the British Columbia Packers Association, who continued operating it.

Cannery was built at Clayoquot in 1895 by Earle & Magneson. It was purchased by the Clayoquot Sound Canning Co. in 1902, by whom it has since been operated.

A cannery was erected at Bute Inlet in 1890 by C. S. Windsor and George Hobson, but only operated the one season.

The West Coast Packing Co. was built and operated at Nootka Sound in 1896, but only secured 112 cases. The plant was dismantled and abandoned. In 1917 a new plant was erected by the Nootka Packing Co., who have since operated steadily.

Dawson & Buttimer built at Alberni Canal in 1903. They sold out to the Wallace Fisheries (Ltd.) in 1911.

Pidcock Bros. built a small cannery at Quathiaski Cove in 1904. They operated it that and the following year and then sold to T. E. Atkins in 1907. This plant was destroyed by fire in 1909, and the following year the Quathiaski Canning Co. built a new plant, which has operated steadily since.

A small cannery was built at Pender Harbor in 1906, by P. H. Alder. It operated for two seasons and was then closed down and dismantled.

J. H. Todd & Sons and the Capital City Canning Co. both built at Victoria in 1905 (the former at Esquimalt). Messrs. Todd & Son still operate, but the Capital City Canning Co. plant was closed and dismantled in 1914.

Capt. R. E. Gosse built at Knight Inlet in 1907 at Sargeants Passage, but moved the plant to Glendale Cove in 1910, and at the close of that season sold the cannery to the Anglo-British Columbia Packing Co., who have since operated it.

The Wallace Fisheries (Ltd.) built a cannery at Quatsino Sound in 1911, but dismantled it in 1914.

The Goletas Fish Co. built at Shushartis Bay in 1914, and after operating for three seasons sold the plant in 1917 to the Western Packers (Ltd.).

The Gilford Fish Co. built a cannery at Kingcombe Inlet in 1914. After operating it that season they sold to the Preston Packing Co.

The Jervis Inlet Canning Co., built a cannery at Jervis Inlet in 1912, operating it that and the following season. In the fall of 1913 it was destroyed by fire. In 1917 the C. L. Packing Co. erected a new plant at Green Bay, Jervis Inlet.

The Nanaimo Canning Co. started at Nanaimo in 1913 and operated until 1916, in which year the plant was acquired by the Nanaimo Canners & Packers (Ltd.).

The Quathiaski Canning Co. was built at Blind Cove in 1916; the Gulf Island Fish Co., at Lasqueti Island, in 1916; and the Sidney Canning Co., at Sidney, in 1916.

The Redonda Island Canning & Cold Storage Co. built a cannery at Redonda Island in 1917, while the Lummi Bay Packing Co., built a cannery at Nitnat in 1917.

In 1918 the Defiance Packing Co. built a cannery at Port Renfrew, while in 1919 the Gosse-Millerd Packing Co. built one at San Mateo.

In 1924 the Somerville Cannery Co. (Ltd.), installed a cannery on its vessel, the *Laurel Whalen*, which packed first at Massett, Queen Charlotte Island, and later moved to Quatsino, Vancouver Island. In 1925 an order in council was promulgated prohibiting any additional floating canneries being put into use and limiting the operations of the above-named plant to one location.

From the inception of the salmon fisheries in northern British Columbia streams salmon fishing was limited to boats operated by oars or sail. In 1924, however, this limitation was removed and operators were permitted to use power boats.

SALMON FISHING IN THE HEADWATERS

Considerable salmon fishing is carried on in the headwaters of certain of the larger rivers of the coast, of which no account appears in the data of the commercial fisheries. This is due to the fact that the fishing is usually of a desultory character, the fisheries are few in number and scattered widely, and while the catch in the aggregate is considerable it does not amount to much in any one spot.

The Columbia River is a typical example of such a stream. Commercial fishing is usually considered as ending at Celilo, about 150 miles from the mouth. As a matter of fact, salmon fishing for market or for home use is carried on to a considerable extent along the main river and also on the Snake and the Yakima, tributaries of the Columbia. In nearly all cases hook and line and spears are used alone, but on the Snake River, near Lewiston, in Idaho, are several rather important haul-seine fisheries. Fishing is carried on at these places in the spring for steelhead trout and in the fall for chinook and silver salmon and steelhead trout. As many as 25 salmon have been taken at one time. While this may seem a small number to one habituated to the large catches farther down the river, in the aggregate it amounts to a considerable quantity.

Considerable local fishing is carried on along the various Oregon streams above the sections usually fished by commercial fishermen. Most of this is done by ranchers living along the streams, and while by far the greater part is for home consumption a small proportion is sold.

On the Yukon River and its tributaries considerable salmon fishing is prosecuted. Much of this is done by natives for the use of themselves and their dogs, but at places white fishermen operate for a portion of the year and sell their catches in near-by settlements or at the mining camps. No effort has ever been made to secure statistics of the extent of this fishery.

APPARATUS AND METHODS OF THE FISHERIES

GILL NETS

The gill net is the oldest and most popular form of apparatus in use in the salmon fisheries of the Pacific coast. There are two kinds, drift and set, these names clearly expressing the difference between them. Fine flax or linen twine is generally used in their manufacture, although in some places cotton twine is employed, and it has usually 12 threads and is laid slack. They are hung in the ordinary manner—to a rope with cork floats to support the upper portion of the gear, and to a line with lead sinkers attached, which keeps the net vertical in the water and all its meshes properly distended. The nets are tanned, usually several times each season.

Drift nets vary greatly in length and depth, depending upon the width of the fishing channels, the depth of water, etc. On the Sacramento River they average about 300 fathoms in length, are 45 meshes deep, and have a stretch mesh of from 7½ to 9½ inches. On the coastal rivers of Oregon these nets average about 125 fathoms in length, and are about 36 meshes in depth, the mesh varying with the species of salmon caught. On the Columbia River the nets average about 250 fathoms in length and have a stretch mesh for chinooks of 9 to 9½ inches. On the Willamette River, the principal tributary of the Columbia, they average about 75 fathoms in length, with meshes of 8 and 9½ inches. On Willapa Harbor drift gill nets run from 100 to 250 fathoms in length, are 30 meshes deep, with stretch meshes of 7 and 8½ inches. On Grays Harbor they average 100 fathoms in length, the chinook nets run from 24 to 45 meshes in depth, with a stretch mesh of 9 inches, while the silver or coho nets are 35 meshes in depth, with a stretch mesh of 7 inches. In northern British Columbia the nets average 150 fathoms in length with a stretch mesh of 5¾ inches. In the Puget Sound region the nets average 300 fathoms in length, with meshes suitable for the particular species sought. In Alaskan waters the nets vary greatly in length and depth, depending upon the places where fished.

Drift gill netting is prosecuted chiefly in the estuaries of the rivers in and near the channels. If the water is clear, the nets are set only at night, but should the water be muddy or discolored with glacial silt, fishing can be carried on either night or day. Night fishing is most common in the States, while day fishing is most common in Alaska. When fishing in rivers, it is necessary to work in a straight stretch of water of fairly uniform depth and free from snags or sharp ledges, these being called "reaches."

In setting the net the boat puller rows slowly across the stream while the other man pays out the apparatus, to the first end of which a buoy has been attached. When about two-thirds of the gear is out, the boat is turned downstream at nearly right angles to her former course, so that the net, when set, approximates the shape of the letter L. The net is laid out at nearly right angles or diagonally to the river's course, so that it will intercept the salmon that are running in, and is usually put out about an hour before high-water slack and taken in about an hour after the turn of the tide. In Alaska the fishermen usually fish on both the high and low slack. The nets are allowed to drift for the time specified, the fishermen drifting along at one end, then the net is hauled into the boat over a wooden roller fixed in the stern, and the fish, which have become gilled in the meshes, are removed, stunned or killed by a blow on the head, and thrown into the bottom of the boat.

Set gill nets are made in the same way as drift nets, in many instances being fragments of the latter, and are usually operated in the upper reaches of the rivers. They vary in length from 10 to 100 fathoms, from 35 to 65 meshes in depth, and have the same sizes of meshes as the drift nets, the size varying, of course, with the species sought for. Sometimes these nets are staked, sometimes anchored, while occasionally only one end is tied to the shore or a stake set in the water.

On the flats off the mouth of the Stikine River, in southeast Alaska, a combination of the drift and set method is followed. A double set of stakes, about 6 feet apart, are set out from the shore for a distance of several hundred yards. An hour or two before slack water the fishermen pay out the net parallel to the line of stakes and about 50 feet from them. The tide drifts the net down until it is caught against the stakes, which retain it until slack water, when the fisherman takes it up and repeats from the opposite direction on the next turn of the tide.

HAUL SEINES

On the Columbia River, where this form of apparatus plays a prominent part in the fisheries, the nets vary in length from 100 to 400 fathoms; the shallowest end is from 35 to 40 meshes deep, but it rapidly increases in width and is from 120 to 140 meshes deep at the other wing. The "bunt," or bag, in the central part of the net is about 50 fathoms long. These nets are usually hauled on the numerous sand bars which are a very noticeable feature of the river at low tide. Buildings are erected on piles on these sand flats, in which the men and horses take refuge at high tide, when the bars are covered with water. Operations begin as soon as the beach or bar uncovers, so that the men can wade about. The net is placed in a large seine boat, with the shore end attached to a dory. At the signal, the seine boat is headed offshore, while the dory heads toward the bar. As the seine boat circles around against the current the net is paid out in the shape of a semicircle. The dory men hurry to the bar with the shore end of the net, the idea being to get that in as soon as possible in order to prevent the escape of the salmon in that direction. As

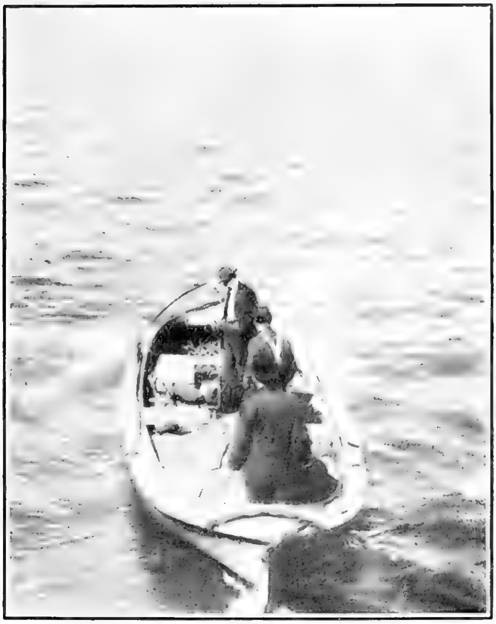

FIG. 8.—COLUMBIA RIVER POWER GILL NET BOAT

FIG. 9.—REMOVING THE SALMON FROM A GILL NET

FIG. 10.—SALMON RACK ACROSS WOOD RIVER, ALASKA

soon as this has been accomplished, the outer shore line is brought to the bar, when several horses are hitched to the line and begin to haul in the net, care being taken by the men to work it against the current as much as practicable, and to get it in as speedily as they can in order to prevent the escape of salmon either by jumping over the cork line or finding some outlet below the footrope or lead line.

The only other place on the coast where haul seines are important is at Karluk, on Kodiak Island, in Alaska. Here the seines are hauled upon the narrow gravel spit dividing the lagoon from the strait, and practically the same method is followed as in the Columbia River.

DIVER NETS

These are in use in the Columbia River, mainly throughout the middle and upper portions of the river. They vary from 100 to 200 fathoms in length and are used almost exclusively for chinook salmon. In construction they somewhat resemble a trammel net. Two nets are attached together side by side. The outer one, or the one toward the oncoming fish, has a larger mesh than the other, so that if the fish manages to pass through the first, it will be caught in the smaller meshes of the second.

DIP NETS

These consist of an iron hoop secured to the end of a stout pole with a bag-shaped net fastened to the hoop. They are generally used at the cascades on the rivers, small platforms being erected upon which the operator stands while fishing. Indians formerly used them to a large extent, but, owing to the steady decline in the number of Indians, and the appropriation of favorable spots by the whites for other forms of apparatus, they are but little used now.

SQUAW NETS

This type is virtually a set net. It consists of an oblong sheet of gill netting, about 12 feet long and 8 feet deep, its lower edge weighted to keep it down, and its upper edge attached to a pole that floats at the surface, and is held by a line or lines to another projecting pole which is securely fastened to the shore, so that it will not swing around with the strain of the swift current on the net. A single block is attached to the pole, and through this passes a rope, thus making a tackle for the more convenient manipulation of the net. The dip-net fishermen of the Columbia River use this net, which derives its name from the fact that it used to be commonly operated by Indian squaws for taking salmon. But few are now in use, for the same reasons as given for the decline in the use of dip nets.

PURSE SEINES

This form of apparatus is in quite general use in Puget Sound and southeast Alaska, and has proved highly effective in these deep, swift waters. These seines are about 200 fathoms long, 25 fathoms in the bunt, and 20 fathoms in the wings, all with a 3¾-inch stretch mesh. The foot line is heavily leaded and the bridles are about 10 feet long. The purse line is made of 1½-inch hemp. The rings through which the purse line is rove measure about 5 inches in diameter and are made of galvanized iron.

Purse seining for salmon in Puget Sound and waters north of same is one of the most important methods in use in the fisheries. In the type of vessel used in this fishery there has probably been greater improvement than in any other branch of the fisheries of the coast. In the early days row scows were in use, but now vessels with power are used.

In 1903 the first gasoline-powered purse seine boat appeared on the Pacific coast salmon fishing grounds in Puget Sound. The vessel was named the *Pioneer* and she was equipped with a 5-horsepower engine. The first season she easily demonstrated her vast superiority over the other purse seiners in the quickness with which she could reach a school of fish after it was sighted and in surrounding it with her seine. The next year there were a few more built or equipped, and the number has steadily increased until at the present time practically all except a few in southeast Alaska are equipped with motor engines.

The first power seine boats were only about 30 feet in length and had small power. As they were few in numbers, there was virtually no competition, and high power and speed were not a necessity. As the boats increased in numbers, however, competition became keener, and the first types of boats with their small power were quickly thrown into the shade by the newer types, which averaged between 45 and 55 feet in length, with 45 to 75 horsepower engines.

When motive power was introduced in the vessels, it was natural that the fishermen should soon introduce winches for the purpose of hauling in the nets, as the whole work could then be done by the one engine.

The purse seine vessels are built with rounded sterns. On an elevated section of the stern is set a movable platform on a pivot. The after end of this platform has a long roller. The purse seine is stowed on this platform, the head rope with corks on one side and the foot line on the other, so that there will be no tangling when the seine is paid out.

When the lookout sights a school of fish the seiner is run down close to it and a rowboat launched. One man takes his place in this with the rope from one end of the seine and acts as a pivot, while the seiner circles around the school, the crew paying out the seine as she moves along. When it is all out, the vessel runs alongside the rowboat and takes aboard the other rope. Attaching this and the rope from the other end to the power winch, the circle around the fish is rapidly narrowed, and the slack of the seine as it comes in is stowed back on the platform. Around the bottom of the seine and through galvanized-iron rings about 5 inches in diameter runs the purse line. As this is hauled into the boat, the open space at the bottom is rapidly closed up just as a handbag would be through the drawing together of the pursing string at the top. During this operation the nonpower purse seiners have a man standing alongside the rail who throws a pole into the center in order to drive the fish away from the open section. He is so skillful in this work that almost invariably the pole comes back to his hand as the pressure of the waters forces it up again. When the bottom has been pursed up the fishermen hauling by hand can move more leisurely, but with the power winches in use the hauling in of the net is a comparatively easy matter, and the pole thrower is dispensed with.

FIG. 11.—DIPPING SALMON FROM THE COPPER RIVER, ALASKA

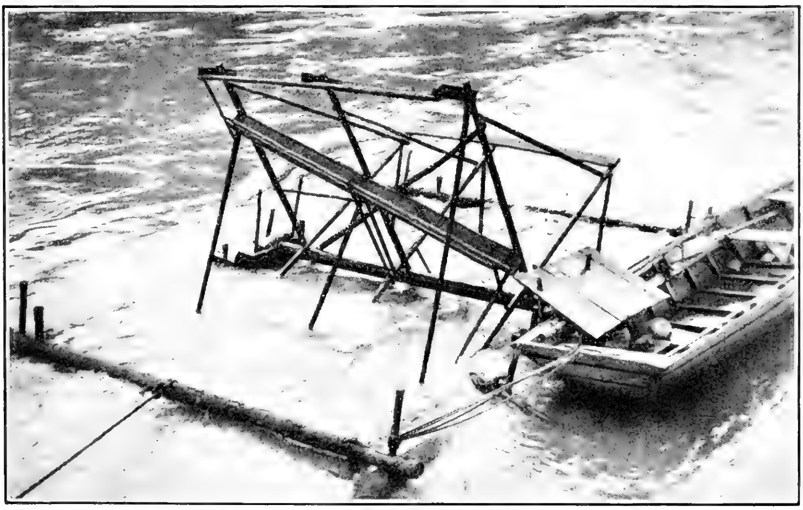

FIG. 12.—FISH WHEEL, YUKON RIVER, ALASKA

FIG. 13.—A SCOW LOAD OF SALMON

FIG. 14.—PURSE SEINE CREW DELIVERING FISH TO CANNERY TENDER

When all the fish are in the bunt and the latter alongside, the fish are generally dipped out by means of a dip net balanced on the end of a tackle. A fisherman lowers it into the seine, scoops up a load of salmon, and as the net is hauled up guides it over the vessel, and then trips it and dumps the fish into the hold.

The Puget Sound purse seiners meet the salmon off the entrance to the Strait of Juan de Fuca and follow the sockeyes till they have passed out of American waters, what are known as the Salmon Banks, off the lower end of San Juan Island, being the principal rendezvous during the run of sockeyes. After this run is over they go up the Sound and fish for chums and cohos, and later go to the head of the Sound and fish for chums, cohos, chinooks, and steelhead trout. In southeast Alaska they follow the fish all over the bays, straits, and sounds of that section. Purse seines are used in a few other places, but the fishery is secondary to those with other forms of apparatus.

This style of fishing is said to have been introduced on Puget Sound by the Chinese in 1886.

TRAPS OR POUND NETS

A trap is stationary and consists of webbing, or part webbing and part wire netting, held in place and position by driven piles. This piling usually is held together above water by a continuous line of wood stringers, also used to fasten webbing to or to walk on if necessary.

In building, the "lead" is first constructed. This runs at right angles, or very nearly so, to the shore, and consists of a straight line of stakes, to which wire or net webbing is hung from top of high water, or a little higher, to the bottom, making a straight solid wall.

At a little distance inshore of the outer end of the lead begin what are called the "hearts." These are V-shaped and turned toward the lead, beginning at a distance of 30 to 40 feet on either side of same and running in the same general direction, the "big heart" or outer heart first, the inner heart, supplementing the first, being smaller, and the end of the outer heart leading into it. Some traps have only one heart. The narrow end of the inner heart leads into the "pot" and forms what is known as the "tunnel." The tunnel ends in a long and narrow opening, running up and down the long way, and is held in position by ropes and rods. Below this is what is known as the "apron," a sheet of web stretched from the bottom of the heart upward to the pot, in order to lead the fish into the tunnel when swimming low in the water, and to obviate the necessity of building the pot clear to the bottom, which would be expensive, as the pots of the traps are usually in quite deep water. If the trap is intended to catch the fish coming from only one direction, the lead generally runs to and is attached to one side of the entrance to the outer heart on the side opposite to that from which the fish are expected.

Some traps have "jiggers" (a hook-shaped extension of the outer heart) on each side, and sometimes on only one side, which help to turn the fish in the required direction.

The "pot" is built out beyond the inner heart and immediately adjoining same. It is a square compartment, with web walls and bottom connected in the shape of a large square sack, fastened to piling on all sides. This pot is hauled up and down by means of ropes and tackles, either by hand or, as is most popular, by steam.

The "spiller" is another square compartment adjoining either end of the pot (sometimes there are two spillers, one at each end), and is simply a container for fish. A small tunnel leads the fish from the pot into the spiller, whence the fishermen lift them out. This is accomplished by closing the tunnel from the pot, after which the ropes holding the front of the spiller are loosened and the net wall allowed to drop almost to the level of the water. A steam or gasoline tug then pushes a scow alongside the spiller and takes position on the outside of this scow. From the deck of the tug a derrick is rigged with a running line from the steam capstan through the block at the top of the derrick. This line is attached to the far end of a net apron, called a "brailer," which is heavily weighted by having chains along each side and leaded crossways at several places. A small boat is run inside the spiller, and the men in this draw the brailer across the barge and let it sink in the spiller. The fish soon gather over it, when the steam capstan quickly reels it in, the net folding over as drawn in from its far side and spilling the fish out on the scow. Men on the scow pick out and throw overboard the undesirable fish. The apron is then drawn back across the pot and the operation repeated so long as any fish remain. In this manner a trap with many tons of salmon in it is quickly emptied.

Traps, like nearly all other fixed fishing appliances, are built on the theory that salmon, like most other fishes, have a tendency to follow a given course in the water, whether a natural shore line or an artificial obstruction resembling one; also that the fish very seldom turns in its own wake. The trap has taken advantage of these natural tendencies of the fish, and is arranged so that, although the salmon may turn, he will continually be led by the wall of net toward and into the trap.

If a trap is located in a place where fish play and where an eddy exists, and the fish run one way with the incoming tide and the opposite with the outgoing, it will fish from both directions; if located where the fish simply pass by, as for instance, on a point or reef, it will fish from one side only.

A variation of the trap, to be used in places where piles can not be driven, is the floating trap. An experimental trap of this variety was used at Uganik, on Kodiak Island, Alaska, as early as 1896. Its use was abandoned in 1897, not to be resumed until some years later. A number of floating traps (of the type invented by J. R. Heckman, of Ketchikan, Alaska) have been and are being used in southeast Alaska, the first having been installed in 1907. The design of this trap follows the shape of an ordinary Puget Sound driven trap. It is constructed of logs, 20 to 26 inches at the butt, bolted and braced together in one solid frame. Suspended from this frame through the logs are 2½-inch pipes extending down in the water 30 feet. Halfway down these pipes and also on the extreme lower ends are eyebolts, to which the web is drawn down and fastened. Thus the web is kept in place as well as if the pipes were driven piles. The lead is also a continuation of large piles or logs bolted firmly together with similarly suspended pipes and webbing.

The so-called wooden traps on the Columbia River are essentially weirs, being a modification of the brush weirs or traps used by the Indians for the capture of salmon long before the advent of the white men. They are built on shore, of piling and planks, the latter

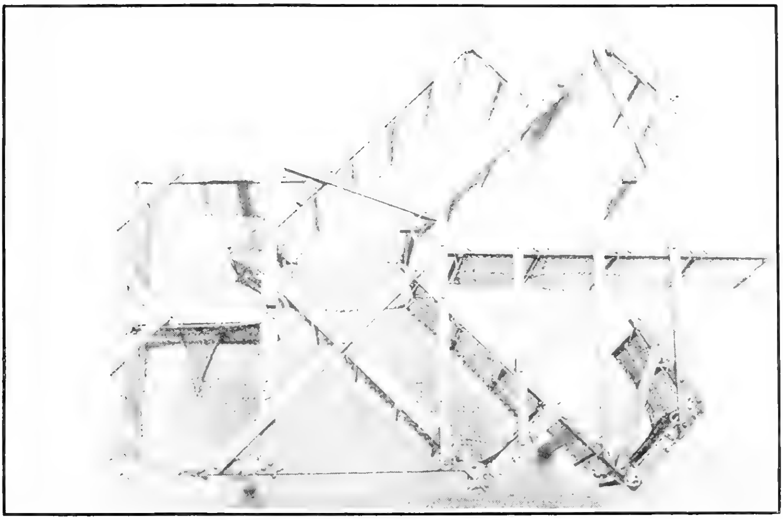

FIG. 15.—FLOATING TRAP

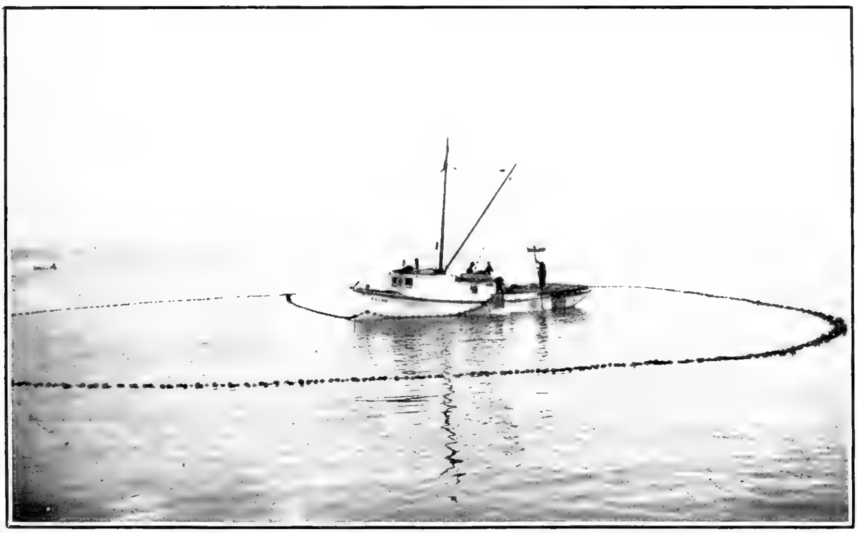

FIG. 16.—PURSE SEINER HAULING IN NET

FIG. 17.—DIPPING SALMON FROM A PURSE SEINE

FIG. 18.—BRAILING SALMON FROM A TRAP

arranged like slats with spaces between. The bowl, or pot, is provided with a movable trapdoor that can be opened during the closed season and on Sundays, so that the fish can pass through and run upstream. These weirs, after being built, are launched into the river, placed in proper position near the shore, and then ballasted so that they sink to the bottom.

According to Collins,[24] "pound nets were introduced on the Columbia River in 1879. In May of that year O. P. Graham, formerly of Green Bay, Wis., built a pound net on the river similar to those used on the Great Lakes. The success of this venture led to the employment of more apparatus of this kind, and many fishermen went west to participate in the fishery."

The first trap on Puget Sound, it is said, was built by John Waller, about 1880, off Cannery Point, at the southeastern corner of Point Roberts.

According to Collins,[25] H. B. Kirby, who had previously fished on the Great Lakes, set a pound net in Puget Sound about 1883, but it was a complete failure. This was set off Point Roberts, near where the Waller trap was set. On March 15, 1888, he again set a pound net, which he had designed to meet the new conditions, at Birch Bay Head, in the Gulf of Georgia. It proved a complete success, and was the forerunner of the present large number which are set annually in these waters.

In Alaska the first trap was set in Cook Inlet about 1885. British Columbia refused to permit the use of pound nets in its waters until 1904, when their use was allowed within certain limited regions.

Some of these traps, especially on Puget Sound, have proved extremely valuable. The years 1898 and 1899 covered practically the high-water mark, as several desirable locations changed hands in those years at prices ranging from $20,000 to $90,000 for single traps, the original expense of which did not exceed $5,000. But few have brought such high prices since, however, owing to the decline in the run of salmon, and at the present time but few of them would fetch much at a sale.

INDIAN TRAPS

The natives, especially in Alaska, have various ingenious methods of catching salmon. In the Bering Sea rivers they catch them by means of wickerwork traps, made somewhat after the general style of a fyke net. These are composed of a series of cylindrical and conical baskets, fitting into each other, with a small opening in the end connecting one with the other and the series terminating in a tube with a removable bottom, through which the captive fish are extracted. Some of the baskets are from 15 to 25 feet in length and are secured with stakes driven into the river bottom, while the leader, composed of square sections of wickerwork, is held in place by stakes.

During the summer of 1910 the author found and destroyed an ingenious native trap set in Tamgas stream, Annette Island, southeast Alaska. This stream is a short and narrow one, draining a lake, about midway of which are a succession of cascades. In the narrowest part of the latter, and in the part up which the fish swim, a rack had been constructed of poles driven into the bottom and covered

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[24] Report on the Fisheries of the Pacific Coast of the United States. By J. W. Collins. Report, U. S. Commissioner of Fish and Fisheries, 1888–89, p. 210. Washington. 1892.

[25] Collins: Op. cit., p. 257.

with wire netting, so as almost wholly to prevent salmon from passing up. Just below, and running parallel to the rack and at right angles to the shore, was placed a box flume with a flaring mouth at the outer end. At the shore end the flume turned sharply at right angles and discharged into a square box with slat bottom and covered over with boughs. The fish in ascending the stream would be stopped by the rack and in swimming around many of them would be carried by the current into and down the flume, eventually landing in the receiving box alongside the shore.

WHEELS

Fish wheels are of two kinds, the floating or scow wheel, which can be moved from point to point if need be, and the shore wheel, which is a fixed apparatus. They operate in exactly the same manner, however. The stationary wheel is located along the shore in a place where experience has shown that the salmon pass. Here an abutment is built of wood and stone, high enough to protect it from an ordinary rise in the river. To this is attached the necessary framework for holding the wheel. The latter is composed of three large scoop-shaped dip nets made of galvanized-iron wire netting with a mesh of 3½ to 4 inches. These nets are the buckets of the wheel and they are so arranged on a horizontal axis that the wheel is kept in constant motion by the current, and thus picks up any fish which come within its sweep. The nets are fixed at such an angle that as they revolve their contents fall into a box chute through which the fish slide into a large bin on the shore. The wheels range in size from 9 to 32 feet in diameter and from 5 to 15 feet in width, and cost from $1,500 to $8,000, the average being about $4,000. A number of them have long leaders of piling running out into the river, which aid in leading the salmon into the range of the wheel.

The scow wheel consists of a large square-ended scow that is usually decked at one end and open at the other. Several stanchions, some 8 to 10 feet high, support a framework upon which an awning is spread to protect the fish from the sun's rays and the crew from the elements. To one end of the scow are fastened two upright posts, which are guyed by wooden supports, while projecting from the same end is the framework which supports the wheel, the latter being constructed in the same way as the stationary wheel, but on a smaller scale. In operation the scow is anchored with the wheel end pointing downstream, and as the wheel is revolved by the current, the fish caught fall from the net into a box chute, through which they slide into the scow. As stationary wheels can be used only at certain stages of water, the scow wheel is a necessary substitute to be used at such times as the former can not be operated, or in places where it is not feasible to build a stationary wheel.

The above forms of wheels are used exclusively on the Columbia River.

An ingenious device is used by some of the wheel operators on the Columbia River in getting their catch to the canneries, a few miles farther down the river. The salmon are tied together in bunches, which are attached to air-tight casks and sent down the stream. At the canneries small balconies have been constructed at the water end of the building. A man armed with a pair of field glasses is stationed here, and as soon as he sights one of these casks he notifies a boatman

FIG. 19.—RACKS AND RUNWAYS FROM WHICH INDIANS GAFF SALMON, CHILKOOT RIVER, ALASKA

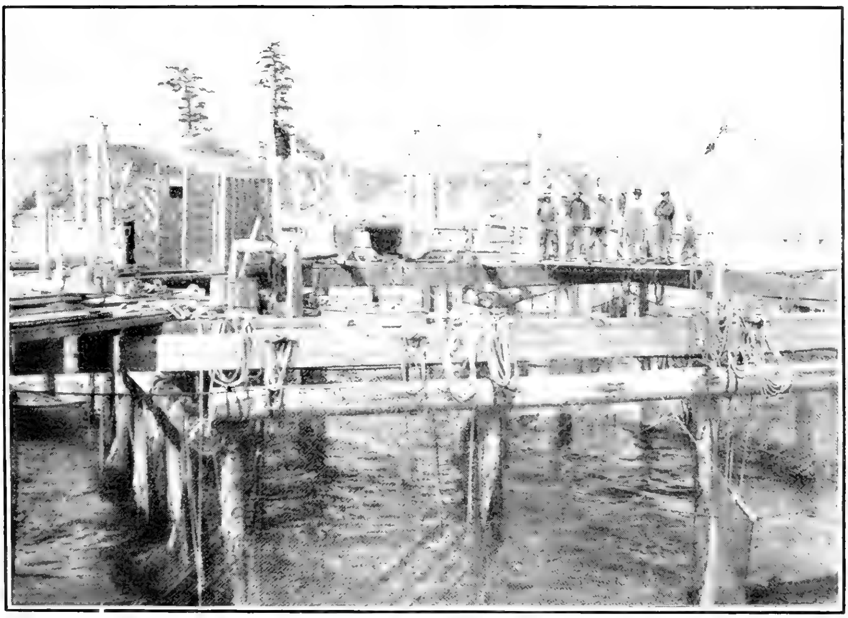

FIG. 20.—THE POT AND SPILLER OF A SALMON TRAP

FIG. 21.—TROLLING FOR SALMON ON PUGET SOUND WITH POWER BOATS

FIG. 22.—PUGET SOUND PURSE SEINE BOATS AT RICHARDSON, WASH

who goes out and tows in the cask and salmon. About 800 pounds of salmon are attached to a keg, and a tag showing the wheel from which shipped is tied to the fish.

In 1908 the first fish wheel to be located in the coastal waters of Alaska was operated in the Taku River, in southeast Alaska. The wheel was set between two 4-foot scows, stationed parallel to each other, and each 40 feet in length. The wheel had two dips, each 22 feet in width and hung with netting. It could be moved from place to place, the same as the scow wheels on the Columbia River. It was operated throughout the king and red salmon runs, but caught almost no salmon, and was not set in the succeeding years.

For many years the natives of the interior of Alaska have been resorting to the banks of the Yukon and Kuskokwim Rivers and their tributaries in order to secure a sufficient supply of salmon to sustain them through the succeeding winter. The favorite apparatus of these natives at present is a type of fish wheel introduced by the whites about 1905. An oblong framework of timbers is constructed in the water and moored to the bank by ropes. A wheel, composed of two or three dips, is placed in this, the axle resting upon the framework. The current catches each dip in turn, thus causing the wheel to revolve, and the dip is of such shape that the salmon caught roll off it into a trough, down which they slide into a boat moored between the wheel and the shore or into a box fixed to the supporting framework on the side. Although crude in construction, these wheels are very effective and a large number of them are set each season.

The Columbia River fish wheel is a patented device. It was first used by the patentees, S. W. Williams & Bro., in 1879, and for several years they retained a monopoly in its use. A number are now operating on the river. The device was not new even when patented, as a similar "fishing machine," as it is called, had been in use prior to this time and is still used by white fishermen on the Roanoke River in North Carolina.

REEF NETS

When the whites first visited the Northwest they found the natives employing a number of ingenious devices for catching salmon, and one of the most effective of these was the reef net. J. A. Kerr, Esq.,[26] who has been engaged in the salmon fisheries of Puget Sound for a number of years, has written the following very interesting account of this native fishery:

> The aborigines the world over have developed ingenuity solely along the lines of their necessities. The coast Indians of Alaska evolved the bidarky and the ingenious implements for taking the seal, the walrus, and the whale. The Siwash of Puget Sound developed a seaworthy dugout and appliances for taking salmon that marks the acme of Indian invention.
>
> When Vancouver explored the waters of the Sound he found over 500 Indians encamped at Chiltenum, now Point Roberts. He relates in his log of the voyage that these Indians were engaged "in fishing for salmon with crude nets made of the bark of young willow." He described the racks upon the contiguous upland used by the Indians in curing the fish.
>
> When Governor Stevens negotiated the treaty with the Indians of the lower Sound at Point Elliott, now Mukilteo, in 1855, I was informed by Colonel Shaw, the interpreter, that over 7,000 Indians attended, the session lasting for five days.
>
> The Government sought to have the Indians confined to reservations, and the disposition of their ancient fisheries was a matter of great solicitude on their part. Salmon was the principal article of their diet.

[26] The Siwash Reef Net. By J. A. Kerr. Pacific Fisherman Yearbook, 1917, p. 60.

After protracted discussion the sixth clause of the treaty was made to provide that "the right to take fish at their usual and accustomed fishing grounds, together with the right to erect and maintain racks upon the contiguous upland for curing and drying the same, is hereby forever guaranteed to said Indians."

There were two of those ancient fisheries on the lower Sound—Point Roberts Reef and Village Point.

The original reef net of the Indians, as described by the first white settlers and by the Indians themselves, was constructed as follows:

The natives peeled the bark from the willow and with it spun a twine and tied a net about 25 feet in width and 40 feet in length, with a mesh substantially of the dimensions and shape of that used in the now familiar pound net.

They then went into the swamps and cut cedar withes. After heating rocks and placing them in pools of water they steamed these withes, after which they twisted them into substantial ropes.

Their reef net operations were confined to the shoal waters over the reefs. The reef net locations were of great value to the Indians, and were considered as property and handed down from father to son. As a rule the Indian families controlling these locations owned an inner and outer location. The reef at Point Roberts is over 1 mile in length.

Reef net fishing was confined to the flood tide. At the beginning of the flood the outer location was used; after the middle of the flood the nets were shifted to the inner locations.

The Indians assembled at the reefs in advance of the salmon run and prepared their appliances.

They first secured heavy boulders or blocks of sandstone from Chuckanut to be used as anchors. They then procured for each net two logs about the length of their canoes. To each end of these logs they tied one of their ropes, about 100 feet in length, the other end of which was fastened to the stone anchor. These logs were anchored over the top of the reef and about 20 feet apart. From the forward end of these logs there was run out at an angle of 45° other ropes to a distance of 50 feet, the outward end fastened to a bouy. To these ropes were fastened stalks of kelp, the ends weighted to the bottom with stones. Thus was constructed a lead operating to concentrate the approaching school of fish between the logs. Then from the front end of these logs there was dropped forward and to the bottom two ropes; from one of these ropes to the other, at intervals of 2 or 3 feet, were fastened cords of willow twine. This appliance was called by the Indians a ladder.

Now in operating the net itself two canoes were lashed on the inside of the logs. Three Indians occupied one canoe and four the other. The net was then suspended between the canoes. The Indians in the forward end of the canoes held the ropes fastened to the bottom of the net; those in the back end held the ropes fastened to the top of the net. The tide running against the net caused it to bag, or purse. The fourth Indian in one of the canoes was generally an elderly man and was called the watcher. He discovered the school of salmon as they were carried into the net and at his signal the Indians at the front of the canoes pulled the lower edge of the net, which was kept within 4 feet of the surface, above the water. The Indians at the middle of the canoe reached down and caught the sides of the net, lifting the sides above the surface. These Indians pulled against each other, the long ropes by which the logs were moored giving enough to allow the canoes to be pulled alongside each other. The fish were then dumped into one of the canoes, after which the net was loosened and lowered, and the boats fell back to their original position again. With these appliances the Indians would take up to 3,000 salmon on a single run of the tide.

This Indian appliance affords not only an interesting illustration of native ingenuity, but as a matter of fact was the forerunner of the pound net. John Waller, a Welshman, was one of the earliest settlers at Point Roberts. He observed the operations of the reef net and in the early 60's constructed at Point Roberts the first pound net ever driven on the Pacific coast. The leads duplicated that of the Indians, while he impounded the salmon by means of the tunnel leading into a web pot, instead of lifting them as impounded.

The reef net marks the humble Siwash as an inventor of some skill, and as a benefactor of some importance, and the apparatus would be in use to-day were it not for the large number of people required to operate it.

At one time this was a favorite device of the Puget Sound natives for catching sockeye salmon. Owing to the large number of men required to work them, and the fact that they can be worked only

FIG. 23.—A COLUMBIA RIVER SCOW FISH WHEEL

FIG. 24.—PUGET SOUND SALMON TRAP

FIG. 25.—A COLUMBIA RIVER STATIONARY FISH WHEEL

at certain stages of tide and in favorable weather, these nets gradually have been supplanted by other devices. In 1909 but five were used, and these were operated off the shores of San Juan, Henry, Steuart, and Lummi Islands, and in the vicinity of Point Roberts. Practically none are used at present.

TROLLING

Each year the catching of salmon by trolling becomes of increasing importance commercially. Although begun a number of years ago the industry never attained prominence until the mild curers created such a persistent and profitable demand for king, or chinook, salmon that the fishermen, who had previously restricted their operations mainly to the use of nets during the annual spawning runs, which last but a small portion of the year, began to follow up the fish both before and after the spawning run and soon discovered that they were to be found in certain regions throughout nearly every month in the year.

Trolling has several advantages from the fisherman's point of view over seine, gill net, and trap fishing. To engage in it, one does not need any very expensive gear, a boat, hooks, and lines being all that are required. Then, there are no licenses to pay and no seasons to observe in many sections, as the fishing is done in many instances beyond the jurisdiction of State waters.

The fishermen comprise all nationalities. While the majority of them are professionals, men of all walks of life are to be found engaging in the business, some on account of their health, others because of reverses in business or lack of work, while still others engage in it from pure love of the outdoor life.

The Monterey Bay (Calif.) trollers use 48 cotton line generally. A few inches below the main lead an additional line is added, with a small sinker on it. This gives two lines and hooks, and as the main line has but the one lead, and that above the junction with the branch line, it floats somewhat above the latter, which is weighted down with a sinker. The main stem is about 20 fathoms in length, while the branch lines are about 5 fathoms each. These lines cost about $3.50 each. No spoon is used, but bait almost invariably. A few fishermen use a spread of stout steel wire, 4 feet long, with 5 or 6 feet of line on each end of the spread, two lines and hooks.

On the upper Sacramento River (mainly at Redding and Keswick) some fishing is done with hand lines. A small catch was made here in 1908, but none were so caught in 1909.

Even as early as 1895 trolling was carried on in the Siuslaw River, Oreg., for chinook and silver salmon.

About 1912 the fishermen living along the lower Columbia River discovered that salmon could be taken by trolling off the bar. A number of them went into the business regularly, while their numbers were greatly swelled by the addition of many of the net fishermen during the regular closed seasons on the river, these not applying to trollers. Some idea of the growth of this fishery off the Columbia River bar may be gained when it is stated that in September, 1915, about 500 boats were engaged in it. It is reported that in 1919 over 1,000 boats were engaged in trolling here.

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At Oregon City and other places on the Willamette River a number of chinook salmon are caught by means of trolling each year, mainly by sportsmen. A spoon is quite generally employed in place of bait. The fishermen claim that the salmon are not feeding at this time, as their stomachs are shriveled up.

For a number of years the Indians living at the reservation on Neah Bay, Wash., have annually caught large numbers of silver and chinook salmon in the Strait of Juan de Fuca. A large number of white fishermen also engage in this fishery at the present time in the same waters, while others troll for the same species, but more particularly silvers, in parts of Puget Sound proper. The ordinary trolling line, with a spoon instead of bait, is used.

Many of the trollers use power boats, and in this event four and sometimes six lines are used. One and sometimes two short poles are run out from each side of the boat (when two are used on a side, one is shorter than the other), the butt being dropped into a chock. Two lines are generally trailed from the stern. At the end of each pole is a very short line with a small tin can attached. A few pebbles are in the can, and as the launch moves slowly through the water with all her lines set, the troller knows when he has a bite by the rattling of the pebbles in the can. Each of the lines attached to a pole is also connected with the boat by a short line from the side to a point on the line about 20 feet from the tip of the latter. When a fish is hooked, the fisherman merely pulls in the line by means of the short piece and then can haul the fish in hand over hand.

The most remarkable trolling region is in southeast Alaska. For some years the Indians here had been catching king salmon for their own use during the spring months, and about the middle of January, 1905, king salmon were noticed in large numbers in the vicinity of Ketchikan. Observing the Indians catching these, several white fishermen decided to engage in the pursuit, shipping the product fresh to Puget Sound ports. They met with such success that 271,644 pounds, valued at $15,600, were shipped. The next year several of the mild-cure dealers established plants in this region, thus furnishing a convenient and profitable market for the catch, and as a result the fishery has grown until in 1928, 3,354,400 pounds of king salmon and 1,320,000 pounds of coho salmon were caught and marketed. The length of the fishing season has also lengthened until now the business is prosecuted vigorously during about seven months in the year, and in a desultory manner for two or three months more, only the severe winter weather preventing operations the rest of the year.

In southeast Alaska the fishermen generally use either the Hendryx Seattle trout-bait spoon No. 5 or the Hendryx Puget Sound No. 8. The former comes in nickel or brass or nickel and brass, the full nickel preferred. The Siwash hook No. 9/0, known as the Victoria hook in British Columbia, is in quite general use. As a rule, but one hook is used, and this hangs from a ring attached to a swivel just above the spoon, while the point of the hook comes a little below the bottom of the spoon. Occasionally double or treble hooks are used. Some fishermen use bait, and when this is done the herring, the bait almost universally employed, is so hooked through the body as, when placed in the water, to stretch out almost straight and face forward as in life.

There are a large number of power-boat trollers in this region. These trollers generally use one pole on a side and one at the stern. The rowboat trollers use but one line, which is attached to a thwart in the boat, handy to their reach when rowing, and trailing out from the stern of the boat.

The trollers usually have temporary camps where they congregate while the fish are to be found in that section, moving on to some more favorable spot when the fish begin to get scarce.

Reports from the trollers of southeast Alaska prove that all species of salmon will take the hook at some time or other in the salt waters of this region, an examination of their stomachs generally showing that they are either feeding or in a condition to feed.

A small commercial fishery is carried on in this region for coho salmon, mainly in August and September, in the neighborhood of Turnabout Island, in Frederick Sound. A Stewart spoon with two hooks on one ring is used, baited with herring in such a way that the fish is straightened out and faced toward the spoon. The sportsmen of Ketchikan also fish with rod and reel for this species in the neighborhood of Gravina Island, using a Hendryx spoon (kidney bait No. 6), which is silvery in color on one side and red on the other. Although much smaller than the king, the coho salmon is more gamey.

During the latter part of March the Gulf of Georgia, in British Columbia, is invaded by large schools of young coho salmon, locally called "bluebacks." They evidently come in from the sea by way of the Straits of Fuca, as their presence is at first apparent in the lower gulf, especially among the reefs and islands off Gabriola Pass. On their arrival these fish are only about a couple of pounds weight, but increase in size very rapidly, with correspondingly voracious appetites. They are to be found in the gulf throughout the spring and summer. By May the fish generally average close to three pounds each when dressed, while in July they are between four and six pounds in weight.

A number of fishermen with power and row boats engage in this fishery, the fish being either sold to the fresh markets or to the canneries.

Trolling lines and spoon baits of one form or another are used. In fishing from power boats the outer lines are attached to fish poles 15 to 18 feet long, rigged out on either side. Those poles are usually hinged at the foot of a short mast and lowered outboard by a halyard running through a block at the masthead, with the additional brace of a forward guy, which, with the drag of the lines aft, holds them in position. It has been customary to use from five to seven lines from each launch, the two outer lines leading from the ends of the poles; the next pair are attached to intermediate tips fastened halfway out on the main pole, while inboard lines are attached to smaller upright rods on either quarter.

The outer trolls are brought within reach (the poles being practically fixtures) by means of a short piece attached to each fishing line 15 or 20 feet from the point where it is fastened to the pole and leading inboard.

Recently, however, the Dominion authorities have decreed that a troller shall not use more than three lines from a boat when trolling for salmon. Should a man be alone in the boat three lines will keep him very busy if the fish are biting at all well.

Spoons are generally used. All shapes are employed, from the ordinary Siwash patterns to wobblers; brass or silver wobblers, of Nos. 4 and 5 sizes, are largely used by the fishermen. Spinners of 2 to 3 inches long are also popular. Copper, copper and silver, and brass spinners of the Siwash and Victoria patterns are very effective, while red beads, feathered hooks, or a piece of silvery salmon skin placed on the hook as an additional bait often add to the attraction of a spoon.

Quite generally the fishermen use single hooks on their spoons. Various lengths of line are used, but on the average about 60 feet for outside lines and 40 for inside are used. As fish can be landed much quicker with a short line, the fishermen generally shorten their lines to 20 or 30 feet when the fish are biting rapidly. Quite heavy lines are used from the pole to the sinker; from there extends a length of light line, and then a piece of wire, to which the spoon is attached. The sinker, which is usually between 2 and 3 pounds in weight when fishing from a power boat and about 1 pound when a rowboat is employed, is attached to the line about 18 feet from the spoon.

The best fishing times are in the early morning and evening, without regard to tidal conditions. The low slack water is always favorable to good fishing.

These fish are delicate flavored, but do not keep well, it being necessary to rush them to market if they are to be sold in a first-class condition.

Considerable numbers of these fish are taken by both American and Canadian fishermen on Swiftsure Banks, off Cape Flattery. As complaint had been made in 1914 that these fish were immature and were unfit for canning because of their appearance after being out of the water some hours, H. T. Graves, acting commissioner of agriculture for the State of Washington, which department is concerned with the wholesomeness of food products, made a thorough investigation of their fitness for food. In a letter to the Pacific Fisherman, Seattle, Wash., and published in that journal under date of August, 1914, he states, among other things, the following:

> The question, therefore, for us to determine was to ascertain their value as a food product. The condition of these fish arriving at the various canneries was carefully noted; samples were selected for bacteriological analysis.
>
> The fish when first taken from the water are very soft when compared with the other salmon. After they have been out of the water 12 hours the fish easily separates from the bony structures, and in the course of ordinary handling in the time which elapses between the hour of taking from the water until they are offered for packing at Sound canneries, which is anywhere from 12 to 48 hours, they become badly broken up and present a rather ugly and distasteful appearance, to say the least.
>
> We found that many different methods of handling were being experimented with by the fishermen and by Puget Sound canneries, but without any noticeable effect. While from a physical observation one would imagine these fish as received at the Sound canneries to be unwholesome, a bacteriological examination by Dr. E. P. Fick, State bacteriologist, indicated that putrefaction was not present, although some of the specimens did contain a rather high bacteria count.

BOW AND ARROW

On the Tanana River, a tributary of the Yukon River, in Alaska, the Indians hunt salmon in birch-bark canoes with bow and arrow. As the canoe is paddled along and the Indian sees the dorsal fin of the salmon cutting the surface of the muddy water he shoots it. The tip of the arrow fits into a socket, and when struck the tip, which when loose is attached to the stock by a long string, comes out of the socket and the arrow floats, easily locating the fish for the fisherman.

SPEAR AND GAFF

Spears of varying shapes and styles have been in use by the Indians from time immemorial and are still employed on many rivers in which salmon run. With the exception of the Chilkoot and Chilkat Rivers of Alaska, practically all of the catch secured in this manner is consumed by the fishermen and their families. In the Chilkoot River the Indians have built numerous racks in the stream and on the banks, upon which they stand and hook the fish out with a gaff attached to a pole.

SPORT FISHING FOR SALMON

The number of sportsmen who improve the opportunity presented by the appearance of feeding springs and cohos is increasing yearly, and in time this promises to far excel the sport salmon fishing of the Atlantic coast.

On Puget Sound and lower British Columbia waters the anglers generally use ordinary trout fishing rods and tackle, with preferably a short trolling tip on the rod when out for coho. Small spinners of silver or copper, of about an inch in length, or else the small double Tacoma spoons, are very good. A strong gut leader or trace of fine piano wire is frequently used, as the fish's teeth would cut through an ordinary line. Where iron wire is used the salt water rusts it rapidly, and unless the precaution is taken to dry off the wire and oil it after using it can not be used for more than a couple of days. Sinkers of an ounce or two in weight are generally employed with fine line.

Many of the small spoons on the market have very cheap hooks, and these are apt to straighten out or break with the strain of a large fish. Hooks of the best steel will, however, stand up to this strain.

One of the favorite spots for anglers is at the falls on the Willamette River at Oregon City, Oreg. Another is on the Clackamas, a tributary which debouches into the Willamette near here. When the spring run of salmon appears in April, hundreds of anglers, many of them from far distant points, appear to participate in the sport during this month and in May. Many noted sportsmen have fished for salmon at these spots. Among them was Rudyard Kipling,[27] and his experiences were woven into a classic short story.

The fishing ground is spread over a mile's length of the river, from Clackamas rapids to the deadline at the falls. It is not an uncommon sight to see 500 boats, each containing from one to six fishermen and fisherwomen, dotting the river on favorable days during the season.

Two methods of fishing are followed. The most popular is to anchor at the head of the Clackamas rapids or in swift water near the falls and allow the rush of water to spin the trolling hook. In the longer lengths of quieter water the sportsmen troll in slow motor boats or rowboats.

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[27] It was in 1889 that Kipling fished here, and his story was reprinted in The American Angler, Vol. II, No. 2, December, 1917, pp. 415–420.

An inexperienced boatman is apt to find fishing in the rapids or near the falls somewhat dangerous, as the swift water may overturn his craft and carry him to his death before help can reach him.

There is a fishway in the dam, so that the fish can pass up this and into the river above the dam. No fishing is allowed closer than 100 feet of the mouth of this ladder. Up to 1915 there was a second deadline, 600 feet from the falls, beyond which no commercial fisherman could operate nets, but the Oregon Legislature in that year closed the Willamette to all net fishermen from the Clackamas rapids to the falls.

The salmon in the spring run on the Willamette will average about 25 pounds each, but examples weighing 50 pounds and over are not uncommon.

In 1914 the Salmon Club of Oregon was formed of anglers who desired to encourage the use of light tackle in the taking of large game fish, in place of the extremely heavy tackle heretofore used. The following rules were adopted:

The rods used may be made of any material except solid bamboo cane. They must not be less than 5 feet in length and weigh not over 6 ounces.

The line must not be heavier than the standard nine-thread linen line.

Any style of reel or spoon may be used and the wire leader must not exceed 3 feet in length.

The angler must reel in his fish, bring it to gaff unaided, and must do the gaffing himself. If a rod is broken at any time during the struggle with the fish it will disqualify the catch.

As a reward of merit the club awards bronze buttons to all anglers taking, on light tackle, salmon weighing 20 pounds or over; for a fish weighing over 30 pounds a silver button is given, and for any salmon over 40 pounds the lucky angler receives a gold button. Numerous additional prizes are also given by public-spirited citizens.

The season for light tackle on the Willamette River and all other inland streams of Oregon has been fixed by the club from January 1 to July 1.

In 1915 the first angler to win a gold button on the Willamette River did so on April 18, when he took a 42½-pound salmon. On the same day this same angler also won a silver button for a 32½-pound fish and a bronze button for a 26-pound fish.

The Seattle Rod and Gun Club, which has a handsome clubhouse on Seattle Harbor, decided to encourage the use of light tackle also, and for this purpose adopted the following regulations as to tackle, how the king or silver salmon may be caught, and offering buttons for fish above a certain size:

CHINOOK, SPRING OR KING SALMON AND SILVER OR COHO SALMON

Tackle.—The tackle recommended is the following: Rod of wood, with butt and tip, and not to be shorter than 6 feet overall; tip to be not less than 5 feet, and to weigh not more than 6 ounces.

A suitable line of linen (9-strand) with breaking strain of not over 25 pounds.

Leader may be of wire or such material as the angler desires, but shall not exceed 6 feet in length.

Only one hook allowed.

A loose sinker allowed.

Any style of reel or spoon may be used.

Rules.—The angler must reel in his fish, bring it to gaff unaided; and must do the gaffing himself, or if he uses a landing net the latter and the gaff hook should not have a handle longer than 2½ feet. No fish to be landed on the shore. If rod is broken at any time during the struggle with the fish it will disqualify the catch.

All fish entered for club buttons or prizes must be entered round and officially weighed by the club weigher and on scales approved by the club and must be weighed within 48 hours after being caught.

Protests as to weight or manner in which the fish was taken must be filed in writing with the club within 48 hours after the fish is weighed in.

Only fish taken within the waters of Puget Sound and the Straits of Juan de Fuca will be allowed for club competition.

Buttons and prizes.—As a reward of merit the club will award buttons to all members who catch chinook, spring or king salmon, and silver or coho salmon with the tackle as noted above and follow the rules established by the club: Chinook salmon weighing 20 pounds or over, a bronze button; chinook salmon weighing 25 pounds or over, a silver button; chinook salmon weighing 35 pounds or over, a gold button; silver salmon weighing 10 pounds or over, a bronze button; silver salmon weighing 12 pounds or over, a silver button; and silver salmon weighing 15 pounds or over, a gold button.

The Tyee Club of Campbell River, on Vancouver Island, British Columbia, which was organized in 1924, and whose members are limited to amateur anglers who have qualified by taking a salmon of 30 pounds or over by the use of rod, reel, and line unaided, is doing much in British Columbia to popularize sport fishing for salmon. Its regulations as to tackle which may be used are the same as those of the Seattle Rod and Gun Club. A bronze button is awarded for a fish of 30 pounds or over or a gold button for a fish of 50 pounds or over. One button only will be awarded a member, but a bronze button may be exchanged for a gold button when won. Only fish taken within the waters bounded by Cape Mudge and Seymour Narrows will be considered.

DANGERS TO THE INDUSTRY

Man is undoubtedly the greatest present menace to the perpetuation of the great salmon fisheries of the Pacific coast. When the enormous number of fishermen engaged and the immense quantity of gear employed is considered one sometimes wonders how any of the fish, in certain streams at least, escape. High water or low water, either of which will prevent certain forms of apparatus from fishing to any extent while such conditions prevail, storms which impede fishing, and the hundred and one small things which in the aggregate are of considerable importance, however, all aid in assisting the salmon in dodging the apparatus and reaching the spawning beds in safety, while, unless the stream is completely blocked by a tight barricade, an indeterminate number of salmon will escape all the pitfalls man and animals may set for them.

Effects of fish culture.—In some sections an almost idolatrous faith in the efficacy of artificial culture of fish for replenishing the ravages of man and animals is manifested, and nothing has done more harm than the prevalence of such an idea.

While it is an exceedingly difficult thing to prove, the consensus of opinion is that artificial culture does considerable good, yet the very fact that this can not be conclusively proved ought to be a warning to all concerned not to put blind faith in it alone.

When salmon are stripped by man, the eggs fertilized and retained in hatcheries until the young are born, and then planted as soon as the yolk sac has been absorbed, it is manifest that the only saving over the natural method is in reducing the loss in the egg stage. We know that many eggs, after being deposited naturally on the spawning beds, are devoured by other fishes, while sudden freshets and occasional droughts also claim their toll of eggs. It is highly probable, although we have no positive data on this point, that these losses far exceed those experienced in artificial salmon culture, and whatever this difference is it represents the extent to which salmon hatcheries should be credited as preservers of the industry.

In the opinion of the author, the best way in which to conserve the fisheries of the coast is by enacting and enforcing laws under which a certain proportion of the runs will be enabled to reach the spawning beds and perform the final and most important function of their lives unmolested. If this is done, there can be no question of the perpetuation of the industry, and if it is then supplemented by the work of hatcheries, which would reduce the loss in the egg stage, assurance on this point would be made doubly sure.

If unrestricted fishing is to prevail, however, with a dependence upon hatcheries alone to repair the ravages of man, the industry will suffer seriously, for, from the very nature of things, less and less fish will annually escape through the fishing zone, resulting in a continually lessening quantity of eggs being obtained at the hatcheries, and finally the latter will have to close down from sheer lack of material upon which to work.

Should eggs be brought to the hatchery from other streams, it would merely be "robbing Peter to pay Paul," and in the end the same result would follow in those streams.

Fortunately these matters are becoming increasingly plain to the people of the various States, provinces, and territories concerned, and, while a few selfish persons in each are seeking solely their own enrichment by any means possible, the greater number of those interested in fishing operations want to see the industry perpetuated and are willing to do almost anything that will work to this end.

Immature salmon.—The rapid increase during recent years of salmon trolling and purse seining on the feeding banks off the mouth of the Columbia River and outside the Strait of Juan de Fuca and elsewhere on the coast has resulted in the taking of large quantities of small and immature salmon, and alarm is now felt lest the runs of chinooks and cohos be seriously depleted. Several thousands of large and small boats are being operated on these grounds from five to eight months of the year, and while, when prices were comparatively low, but few of these immature fish were marketed, the high prices which have prevailed during the last four years have caused such an intensity of fishing that many thousands are now caught each season.

Investigations [28] by experts off the mouth of the Columbia in 1918 show that a large proportion of the chinook salmon caught by trolling are 2 and 3 years old. These are generally sold to the canners, who separate them into two groups, those under 5 pounds and those over. Those under 5 pounds are called "graylings" by the fishermen, but a mere glance at them is sufficient to establish their real identity. The reports of one cannery during the period from May 11 to May 29 showed there had been received 4,061 pounds of these fish, none of which weighed 5 pounds. From May 30 to June 12 this same cannery received 548 of these fish having a total weight of 1,483 pounds. As the owner of this cannery was decidedly opposed to the purchase

[28] The Taking of Immature Salmon in the Waters of the State of Washington. By E. Victor Smith, State of Washington, Dept. of Fisheries. 44 pp., 8 pls. 1920.

of these fish, and only bought them because his regular fishermen would have gone to other cannerymen with their full-sized fish had he not taken the immature ones, it is probable that the cannerymen who were not opposed to the practice received a greater proportion of immature fish than he.

An idea of the smallness of these immature salmon may be gained when it is stated that the average weight of sexually mature chinook salmon running into the Columbia River is about 22 pounds.

These small chinooks are said to produce a very inferior quality of canned goods, being rated as second and third grade. The meat is of an ashy color, poor in fat content, and insipid in taste.

Off the Strait of Juan de Fuca the same condition of affairs existed as off the Columbia River, with the added complication that many immature cohos were also captured.

The immature feeding coho deteriorates when taken from the water even more rapidly than does the immature feeding chinook. Within 24 hours of being taken from the water the abdomens may be broken open, the ribs protrude freely, and the flesh begins to deteriorate. It was early found that it was impossible, except through the exercise of extraordinary precautions, to get these fish to the up-sound canneries before it was too late, so that of recent years only canneries situated adjacent to the banks were enabled to use them.

The sale of young salmon in the fresh fish markets of Seattle and other Puget Sound cities has been common for years. They are marketed usually as "salmon trout." On the Columbia River they usually are called "grayling."

It is an economic crime to catch and kill these immature salmon, as but little money is obtained for them, while if they were allowed to attain maturity they would increase in weight, in the case of the chinook nearly 1,000 per cent on the average and in the case of the coho about 100 per cent in four or five months' time.

Another bad feature of trolling operations off the mouth of the Columbia River is that trollers, because they operated outside the 3-mile limit, were exempted from the observance of the regular closed season, operative in the river from August 25 to September 10. As a result of this, fishing was carried on continuously throughout the run; most of the gill netters who had to stop fishing in the river put their nets ashore and went outside and engaged in trolling, while canneries on the river bought and canned all the fish brought in. In 1917 the Washington Legislature enacted a law prohibiting possession within the State during the closed season, except for personal use, of salmon caught beyond the 3-mile limit outside the Columbia River. The State court, on trial, held this to be unconstitutional as being an interference with interstate and foreign commerce.

Oregon also adopted the same law as Washington, and on trial this was upheld as constitutional on October 3, 1919, by the Oregon circuit court. However, the law will be of no value if valid in only one State, as if enforced there the fishermen will sell their catches in the other State.

It is quite plain that the salmon runs entering the Columbia River and the Strait of Juan de Fuca can not long continue to exist under this terrific drain upon the immature and mature fish. In the latter section the sockeyes and humpbacks are rapidly being exterminated, and it is probable that the chinooks and cohos, the especial victims in this attack, will soon show signs of exhaustion.

The State authorities appear to be helpless in these matters, but an enactment by the Federal Government could be maintained, as the principle has been applied to fishery matters elsewhere, notably the spring mackerel closed season for five years and the sponge law relating to the landing of undersized sponges taken from the grounds off the Florida coast.

Pollution of streams.—Next to the fishing operations of man, the gravest danger to the salmon fisheries of the Pacific coast lies in the pollution of the rivers which the salmon ascend for spawning purposes. The salmon, both old and young, require pure cold water, and the immense runs which have annually ascended the streams for many years are doubtless due to the fact that such conditions have prevailed in them. The large increase in the population of the coast States within recent years, with the resulting increase of mills and factories, has greatly increased the amount of sewage from cities and towns and the waste of the manufacturing plants. Many of the latter have also constructed dams without adequate fishways, and these also wreak great havoc to the industry by cutting the fish off from the upper reaches of the rivers upon which constructed.

The emptying of sewage into streams ought to be made a crime. It is an exceedingly crude method of dealing with it, and, instead of disposing of the filth, merely transfers it from one place to another, making the water unfit for use at points farther downstream and spreading diseases and death amongst not only the finny but also human users of it.

In the present condition of sanitary science it is a comparatively easy matter to dispose of this filth by modern septic devices, and a number of cities are now disposing of their sewage in this manner.

The irrigation ditch, a comparatively new product on this coast, while of great benefit in developing the arid lands in certain sections, as at present operated is a considerable menace to the salmon fisheries. But few ditches have screens at their head, and as a result many thousands of young salmon slowly making their way to the ocean home pass into and down these to an early doom. Every owner of such a ditch should be compelled to place at its head a screen with fine enough mesh to prevent absolutely the passage through the same of even the tiniest baby salmon.

Animal enemies.—Next to man and his methods the trout is undoubtedly one of the greatest enemies of the salmon. The Dolly Varden follow the salmon from the sea to the spawning beds, and when the eggs are extruded devour countless thousands of them. Many and many a time the writer has seen on the spawning beds female red salmon swimming around with a cloud of trout spread out behind like a fan, following her every movement, eagerly waiting for the moment when the eggs shall appear.

In the summer, when the young are heading for the sea, the trout are lying in wait for them and again take their toll of countless thousands.

Much is said by certain people of the ravages amongst the salmon of certain animals, as the seal, sea lion, bear, eagle, kingfisher, crane, duck, loon, and hawk. While in the aggregate the ravages of these animals are considerable, they are not a drop in the bucket as compared with the direct or indirect ravages of man and his agencies.

FISHING SEASON IN ALASKA

There is much interest manifested in the beginning and end of the salmon-fishing season for the more important waters of the various regions of Alaska. The following table, extracted from United States Bureau of Fisheries Document No. 838, Alaska Fisheries and Fur Industries in 1916, pages 48 and 49, gives dates taken from the statistical reports made by the canning companies. The earliest one reported by any company doing much fishing has been accepted as an opening date, while the closing date was determined by taking the day nearest to which major operations ceased.

Fishing season in the canning industry for salmon caught in certain important waters in Alaska in 1916

Locality	Coho		Chum	
	Fishing began—	Fishing ended—	Fishing began—	Fishing ended—
Southeast Alaska:				
Chatham Strait	June 1	Sept. 27	June 1	Sept. 30
Prince of Wales Island, west side	June 15	Sept. 23	July 1	Do.
Cordova Bay	do	do	do	Do.
Clarence Strait—				
Southern section	June 10	Sept. 29	June 27	Sept. 29
Northern section	July 20	Sept. 30	Aug. 13	Oct. 17
Behm Canal	June 15	Oct. 20	June 15	Oct. 20
Revillagigedo Channel	June 27	Sept. 29	June 27	Sept. 29
Stephens Passage	July 4	Oct. 4	June 22	Oct. 3
Peril and Sumner Straits	June 24	Sept. 27	July 1	Sept. 30
Frederick Sound	June 22	Sept. 21	Sept. 14	Sept. 23
Icy Strait and Cross Sound	June 15	Sept. 20	May 29	Sept. 27
Lynn Canal	July 7	Oct. 1	July 7	Oct. 1
Baranof Island, west side	July 4	Sept. 20	June 20	Sept. 20
Chichagof Island, west side	Aug. 15	Sept. 15	Aug. 5	Sept. 15
Portland Canal	Aug. 16	Sept. 9	July 8	Sept. 3
Iphigenia Bay	June 8	do		
Yakutat Bay and vicinity	Aug. 25	Sept. 28		
Central Alaska:				
Bering River				
Martin River				
Copper River Delta	May 12	Sept. 24	May 12	Sept. 24
Copper River, lake and canyon	May 31	Sept. 16	May 31	Sept. 16
Controller Bay	Aug. 24	Sept. 25		
Cook Inlet	July 2	Aug. 27	June 24	Aug. 23
Prince William Sound—				
Eastern section	July 1	Sept. 30	June 23	Sept. 24
Western section			July 7	Aug. 4
Afognak streams—				
Western part				
Eastern part	Aug. 15	Oct. 20		
Karluk	June 3	Oct. 2	June 3	Oct. 2
Red River			June 8	July 21
Uganik	Aug. 15	Oct. 10		
Olga Bay	June 8	Sept. 1	June 8	Sept. 1
Chignik Bay	June 28	Sept. 9	June 12	Sept. 8
Ikatan Bay	May 22	July 25	May 22	July 25
Cold Bay, Thin Point, and King Cove	June 28	Aug. 15	June 28	Aug. 15
Morzhovoi Bay	June 9	Aug. 11	June 9	Aug. 11
Pavlof Bay				
Western Alaska:				
Kvichak Bay	June 11	Aug. 1	June 11	Aug. 1
Naknek, Egegik, and Ugashik Rivers			June 21	July 31
Nushagak Bay	June 11	Aug. 4	June 11	Aug. 4
Nushagak River	June 24	Aug. 6	June 23	Aug. 6
Port Moller	June 7	Aug. 9	June 7	Aug. 9
Nelson Lagoon			July 1	Aug. 7
Kotzebue Sound	July 20	Sept. 1		

Fishing season in the canning industry for salmon caught in certain important waters in Alaska in 1916—Continued

Locality	Humpback		King		Red	
	Fishing began—	Fishing ended—	Fishing began—	Fishing ended—	Fishing began—	Fishing ended—
Southeast Alaska:						
Chatham Strait	June 1	Sept. 30	June 1	Sept. 22	June 1	Sept. 12
Prince of Wales Island, west side	July 1	do			June 15	Sept. 23
Cordova Bay	June 15	do			do	Do.
Clarence Strait—						
Southern section	June 27	Aug. 16			June 8	Sept. 29
Northern section	Aug. 13	Oct. 17	June 27	Aug. 30	July 13	Sept. 7
Behm Canal	June 15	Oct. 20			June 15	Oct. 16
Revillagigedo Channel	June 27	Sept. 29	June 16	July 16	June 27	Sept. 29
Stephens Passage	June 22	Sept. 21	May 9	July 12	June 21	Oct. 3
Peril and Sumner Straits	June 21	Sept. 30			June 27	Sept. 9
Frederick Sound					June 22	Sept. 21
Icy Strait and Cross Sound	June 1	Sept. 27	May 21	July 15	May 21	Sept. 15
Lynn Canal	July 7	Aug. 24			June 24	Oct. 1
Baranof Island, west side	June 20	Sept. 20			June 8	Sept. 20
Chichagof Island, west side	Aug. 1	Sept. 15			Aug. 1	Sept. 1
Portland Canal	July 8	Sept. 3			July 8	Aug. 18
Iphigenia Bay	June 8	Sept. 9			June 8	Sept. 9
Yakutat Bay and vicinity	July 15	Aug. 10	June 2	Aug. 4	June 2	Aug. 4
Central Alaska:						
Bering River			June 22	June 28	June 6	Aug. 7
Martin River			May 12	July 9	June 12	July 9
Copper River Delta	May 12	Sept. 24	do	do	May 12	Aug. 15
Copper River, lake and canyon	May 31	Sept. 16	May 31	Sept. 16	May 31	Sept. 16
Controller Bay	July 23	Aug. 8			May 27	Aug. 15
Cook Inlet	June 27	Aug. 27	May 27	Aug. 27	May 30	Aug. 27
Prince William Sound—						
Eastern section	June 28	Sept. 24			June 20	Sept. 24
Western section	July 9	Aug. 1			June 17	July 23
Afognak streams—						
Western part	June 20	Aug. 15			May 15	July 31
Eastern part	July 15	Sept. 16			June 1	Oct. 20
Karluk	June 3	Oct. 2	June 3	Oct. 2	June 3	Oct. 2
Red River	June 8	July 21			June 8	July 21
Uganik	June 5	Oct. 10			June 5	July 27
Olga Bay	June 8	Sept. 1	June 8	Sept. 1	June 8	Sept. 1
Chignik Bay	June 12	Aug. 31	June 12	Aug. 31	June 12	Sept. 9
Ikatan Bay	May 22	July 25	May 22	July 25	May 22	July 25
Cold Bay, Thin Point, and King Cove	June 28	Aug. 15			June 28	Aug. 15
Morzhovoi Bay	June 9	Aug. 11	June 9	Aug. 11	June 9	Aug. 11
Pavlof Bay	Aug. 7	Aug. 15				
Western Alaska:						
Kvichak Bay	June 11	Aug. 1	June 11	Aug. 1	June 11	Aug. 1
Naknek, Egegik, and Ugashik Rivers			June 21	July 31	June 21	July 31
Nushagak Bay	June 11	Aug. 4	June 11	Aug. 4	June 11	Aug. 4
Nushagak River	June 17	Aug. 6	June 8	July 28	June 13	Aug. 6
Port Moller	June 7	Aug. 9	June 7	Aug. 9	June 7	Aug. 7
Nelson Lagoon			do	July 21	do	Aug. 9
Kotzebue Sound						

FISHERMEN AND OTHER EMPLOYEES

FISHERMEN

White men do the greater part of the fishing for salmon, many nationalities being represented, but Scandinavians and Italians predominate almost everywhere. A number of Greeks are to be found fishing in the Sacramento, while Slavonians do most of the purse seining on Puget Sound. The native-born American is not often found actually engaged in fishing, but frequently is the owner of the gear or has a responsible position in the packing plants.

A number of Indians participate in the fisheries of Alaska and a few fish in Washington. The only Chinese engaged in fishing are in Monterey Bay. A number of Japanese also fish in this bay, which is the only place in American territory where they fish for salmon. A considerable number of Japanese engage in fishing in Canadian waters.

In many places on the coast, particularly in Alaska, fishing is a hazardous occupation. In Alaska most of it is done in the bays, sounds, and straits, where storms are frequent, and the annual loss of life is heavy. The records of the Alaska Fishermen's Union show for its members the following losses of life by drowning: 1905, 10 men; 1906, 5 men; 1907, 10 men; 1908, 17 men; and 1909, 17 men.

The fishermen early saw the advantages of organization, and nearly every river now has a union which is subordinate to the general organization. One of the most typical of these is the Alaska Fishermen's Union, which has active jurisdiction over all sections of Alaska except a portion of southeast Alaska. This organization enters into contracts with the salmon canneries and salteries, by which the rates of wages, duties, etc., of the fishermen are fixed in advance for a certain period—three years—up until 1918, when an agreement was made for only one year. The same was true in 1919. At present agreements are for 3-year periods. As a result of this mutual agreement upon terms but little trouble is experienced with the fishermen, who generally conform scrupulously to the terms of the contract, and strikes and bickerings, which were very common some years ago, are now almost entirely absent.

CANNERY LABOR

NATIONALITIES

In the early days canning was a haphazard business and workmen came and went as common laborers do in the wheat fields of the West. As the business increased in importance and the need of skilled labor became imperative, men were put to certain work and kept at it from season to season, with the result that in a few years a corps of highly skilled workers had been evolved, and this had much to do with the rapid extension of the industry.

For many years Chinese formed the greater part of the cannery employees, the superintendent, foreman, clerks, machinists, and watchmen alone being white. No other laborers have ever been found to do the work as well or with as little trouble as the Chinese. In times of heavy runs, when the cannery would have to operate almost day and night in order to take advantage of what might be the last run for the season of the sometimes erratic salmon, the Chinese were always willing, even eager, to do their utmost to fill the cans, and, if fed with the especial food they insisted upon having and due regard was had to certain racial susceptibilities, the cannery man could almost invariably depend upon the Chinese doing their utmost.

The Chinese-exclusion law cut off the supply of Chinese, and as the years went by and their ranks became decimated by death, disease, and the return of many to China, the contractors were compelled to fill up the rapidly depleting crews with Japanese, Filipinos, Mexicans, Porto Ricans, etc., with the result that to-day in many canneries special quarters have to be provided for certain of the races—more particularly the Chinese and Japanese—in order to prevent racial hatred from engendering brawls and disturbances.

In Alaska and at a few places in the States Indians are employed in the canneries. In Alaska more would be employed if they could be secured. They make fair work people, but are rather unreliable about remaining through the season.

CHINESE CONTRACT SYSTEM

Cannery labor is supplied largely through the contract system. In the large cities along the coast are agencies, mainly owned by Chinese, which make a specialty of furnishing labor for canning. In the agreement between the canning company and the contractor the company guarantees to pack a certain number of cases during the coming season, and the latter agrees to do all the work from the time the fish are delivered on the wharf until they are ready to ship at the end of the season for a certain fixed sum per case. Should the cannery pack more than the guaranteed number, which it usually does if possible, the excess has to be paid for at the rate per case already agreed upon, while if the pack for any reason should fall below the contract amount, the company must pay for the shortage the same as though they had been packed. The company transports the Chinese to the field of work and carries them to the home port at the end of the season. It provides them with a bunk house and furnishes fuel, water, and salt. The contractor sends along with each crew a "boss," who has charge of the crew and furnishes their food, the company transporting this free.

While this contract system met with favor from some of the cannery men because it relieved them from the annoyance and trouble involved in hiring, working, and feeding their cannery gangs, others, and these the most farsighted, from the early days of the industry viewed it with suspicion and distrust and in a few instances refused to have anything to do with it. While the plan apparently met with no objection from the Chinese when they were the only ones engaged in the work, as soon as other races began to be employed disputes became common, and it is probable that to-day it is the most unpopular feature of the industry from the common workers' standpoint, and mainly because of the abuses which have grown up in connection with it.

Since the beginning of the present century there has been a steady expansion of the salmon-canning industry, with a consequent heavy demand for cannery labor. As a result of the operation of the Chinese-exclusion act during this period the number of Chinese available has been steadily declining; in fact, most of the Chinese now employed are mainly men well along in life, as the few comprised in the rising generation do not wish to follow in their fathers' footsteps. As a result the oriental gang now comprises many nationalities.

The great increase in the number of canneries during the period noted, with the resulting demand for labor, led to the introduction of other nationalities, more notably the Japanese, into the ranks of the Chinese contractors. Many of these operated with very little or no capital and when a bad season occurred they usually passed their losses, in whole or in part, onto their workers, usually by absconding, and when the latter attempted to come back onto the owner of the plant the latter successfully pleaded the fact that he had made a contract with the contractor to do the work at a certain fixed sum per case, that the stipulated price had been paid him, and if he failed to settle with the men it was no concern of the canner.

The contractor, under his agreement with the canner, has the right to feed his employees from the time they leave the home port until they return, and this is a most prolific source of profit and graft to him and of trouble to the canner. When the workers comprise orientals alone, the food question rarely troubles, as then rice, which is the staple food and is also as a rule quite cheap, meets with the approval of all. But since the gangs now comprise almost as many nonorientals as there are orientals, and the former find it impossible to exist, let alone thrive, on rice, much trouble results when the contractor furnishes them with an undue proportion of the latter in the daily menu. As a result of this condition of affairs, some of the more far-seeing companies now compel the contractor to furnish each nationality with food to which they are accustomed and in sufficient quantities. Eternal vigilance is required in this matter, however, as the wily oriental is always seeking an opportunity to increase his profits by cutting the quantity of food to the minimum and by forcing as much rice as possible upon the employees. Innumerable strikes in the canneries can be traced directly to dissatisfaction with the quantity, kind, and quality of food furnished to the men by the contractor's agent; and the resulting losses, which are sometimes very large, as the strikes generally occur when the cannery has plenty of fish, fall upon the cannery men.

Nearly all of the workers are ignorant men; in most cases they have but little knowledge of English, the language in which the contract is printed, and as no paternal Government watches over them to see that they understand thoroughly the terms of the contract and that it is fulfilled on the part of the employer, as is done in the case of the sailors and fishermen, some of them discover at the end of the season that their pay does not come up to the glowing promises of the agent who recruited them and also frequently discover that there are various fines provided for in the contract, which, while they do not work an injustice when the contractor is honest, yet in the hands of an unscrupulous and grasping contractor, frequently operate to the financial disadvantage of the worker.

Some of the dishonest contractors have developed other methods for fleecing their employees. Sometimes they will furnish to their contract workers, either directly or through some concern in which they have financial interests or which will pay them a commission, an outfit comprising clothing, blankets, shoes, etc., at a price two or three hundred times its real value. The worst feature of many of these outfits is that they are woefully inadequate for use in the climate to which the cannery ship is bound. Some unscrupulous contractors also sell goods to the workers at extortionate prices while at the cannery. The latter is usually not permitted by the canners, who generally operate a store of their own where the men can as a rule obtain goods as cheap as they can be bought in either San Francisco or Seattle.

Orientals are inveterate gamblers, and there are usually several sharpers with each cannery gang, generally with the connivance of the contractor's agent—although it is usually an impossibility to prove this legally—and they inveigle the green hands into all sorts of gambling games, and in this manner frequently succeed in winning all or part of their season's wages. That those in charge of the gang are well aware of what is going on is patent when it is stated that the men are not paid off until they return to the home port at the end of the season, and that no considerable claim on the wages due a worker can be paid unless the contractor or his agent knows what it is for.

Sometimes when dealing with a canner who is insistent upon seeing justice done to the members of the oriental gang, and the number of these is increasing rapidly, an effort is made to camouflage these gambling debts by charging them up on the books as clothing or goods furnished the worker.

As a result of these evils, a number of the cannerymen have discontinued the practice of making Chinese contracts and deal directly with their men. When this is done, it is but rare to hear of a strike due to food supplied, as the cannerymen, when the matter is put directly up to them, realize that the only way in which they can expect adequate work from their employees is by seeing that they are given the proper kind and quantity of food and that they operate under decent working and living conditions.

A few of the cannerymen who still retain the old system endeavor to eradicate so far as possible the evils of it by a close supervision over the food supplied the men and by having a representative present at the season's pay-off in order to see that no attempt is made to cheat the men out of their wages. Unfortunately, however, some of them feel that they have done their full duty when they have made a contract with someone, no matter what his financial responsibility may be, and have paid him the agreed upon sum at the end of the season, doubtless feeling that the rest is the concern alone of the men.

In a very few instances the members of the oriental gang are still shoved into inadequate and insanitary quarters aboard ships, and at the canneries are housed in quarters which are a disgrace to any modern packing plant, but, fortunately, these conditions, as stated, prevail now with but comparatively few of the companies. The old "China" house, in which was housed the whole oriental gang like rabbits in a warren, has been largely superseded by cottages, each housing from 8 to 16 men, and these are numerous enough to permit of the various nationalities flocking by themselves. Bathing facilities, with hot and cold water, are fairly common, and opportunities for washing clothing are frequent.

FISHERIES OF BOUNDARY WATERS

Waters which form the boundaries between States or between nations, and in which fishing is carried on by the citizens of both, have almost always proved bones of contention, and the Pacific coast has been no exception to the rule.

WASHINGTON AND OREGON

The Columbia River, which forms the boundary between Oregon and Washington, affords a typical example of the evils which can result from a division of responsibility between two States. For many years each State enacted laws regulating the fisheries of the river with very slight regard usually to laws already in force in the other State. As a result of this the fishermen transferred their residence for license purposes from State to State as the laws of one or the other best suited their particular purposes.

The fishermen and packers also were in apparently irreconcilable conflict as to the proper means to be taken to conserve the fisheries, and each session of the legislatures saw strong lobbies present to work for certain selfish ends, while the few earnest men who had the real welfare of the fisheries of the river at heart had difficulty in making the slightest headway against the influence of these lobbies.

To further complicate the matter, in 1894 Oregon claimed that, under the provisions of the enabling act admitting it as a State, it had jurisdiction to the Washington shore, and proceeded to arrest Washington men who were fishing in what was the open season according to Washington law but the closed season under Oregon law.

In June, 1908, the voters of the State of Oregon had presented for their consideration two bills radically affecting the waters of Columbia River. One proposed closing the river east of the mouth of the Sandy River against all fishing of any kind except with hook and line, and was originated by gill-net fishermen of the lower river for the purpose of eliminating fish wheels in the upper waters. This bill was the first presented to the people, and when it appeared the upriver men retaliated by presenting a bill affecting the lower river to such an extent that it practically prohibited the net fishermen from operating.

Very much to the surprise of all concerned both bills were passed and became laws on July 1, to take effect, as provided, on August 25 and September 10, respectively. The Oregon master fish warden proceeded to enforce both laws, arresting all violators on both sides of the river, irrespective of whether or not they were operating under a Washington or Oregon license, and incidentally did the fisheries a great service by bringing prominently before the public the anomalous condition of affairs which was occasioned by the archaic system under which the fisheries of the Columbia were governed. The State of Washington appealed to the United States courts, which, after argument, issued an injunction preventing the warden from enforcing the laws so far as the Washington fishermen were concerned.

In the meantime the attention of the General Government had been drawn to the apparently irreconcilable conflict between the two States, and fearing that in the mêlée the interests of the fisheries would be lost sight of, President Roosevelt, in a message to Congress, after reciting briefly the lack of harmony in jurisdiction by the States, recommended that the General Government take over the control of the fisheries of the Columbia, as well as other interstate rivers.

This had the effect of bringing matters to a head, and negotiations were soon in progress looking to the preparation of a treaty between the two States by which uniform laws would be adopted, and thus each State have concurrent jurisdiction to the opposite shore of the river. The legislatures each appointed a committee of eight members to confer and frame joint legislation. The two committees met in Seattle, Wash., early in 1909, and agreed upon the following recommendations:

First. A spring closed season from March 1 to May 1.

Second. A fall closed season from August 25 to September 10.

Third. A Sunday closed season from 8 p. m. Saturday of each week to 6 p. m. the Sunday following between the 1st day of May and the 25th day of August.

Fourth. We suggest the mutual recognition by each State of the licenses issued to floating gear by the other State.

Fifth. That the State of Oregon repeal chapter 89 of the session laws of Oregon for the year 1907, relative to the operation of purse seines and other like gear on the Columbia River.

Sixth. We recommend the enactment of similar laws in both States carrying an appropriation of at least $2,500 in each State and providing for the destruction of seals and sea lions and the granting of a bounty on the same, to be $2.50 for seals and $5 for sea lions.

Seventh. We recommend the repeal of both the fish bills passed under the provisions of the initiative and referendum in June, 1907, by the people of the State of Oregon, said bills being designated on the ballot as 318, 319, and 332, 333.

The recommendations were enacted into law by both States, and at the same time the State of Washington in its bill also prohibited fishing for salmon within 3 miles of the mouth of the Columbia between March 1 and May 1 and between August 25 and September 10, or salmon fishing on tributaries of the Columbia, except the Snake, between June 1 and September 15; and also prohibited fishing for salmon by any means save by hook and line in the Kalama, Lewis, Wind, Little White Salmon, Wenatchee, Methow, and Spokane Rivers and in the Columbia River 1 mile below the mouth of any of the rivers named. The agreement was subjected to a rather severe strain, however, when it was discovered that the Oregon Legislature had failed to provide the same closed periods for the tributaries that were enacted for the Columbia, thus leaving the Willamette, Clackamas, Lewis and Clark, and Youngs Rivers and Spikanon Creek open to fishing for 15 days in March and 15 days in April, while the Columbia was closed. The cry of bad faith was at once raised by the Washington fishermen, and for a short time it appeared that the agreement would be broken at the very beginning. The Oregon Board of Fish Commissioners took the matter up, however, and by order closed these streams to all fishing during the times of closed season on the Columbia, and thus restored peace once more.

This agreement continued in force until 1915, when the legislature of each State prepared for a thorough revision of its fishery code. In order to make this revision more effective, committees from both legislatures were appointed and held joint meetings in Portland, where they mutually agreed upon laws covering the fisheries of the Columbia River, and in order to make this agreement more binding the following chapter was inserted in the codes finally adopted:

All laws and regulations now existing, or which may be necessary for regulating, protecting, or preserving fish in the waters of the Columbia River, over which the States of Oregon and Washington have concurrent jurisdiction, or any other waters within either of said States, which would affect said concurrent jurisdiction, shall be made, changed, altered, and amended in whole or in part only with the mutual consent and approbation of both States.

As such an agreement between two States requires the approval of Congress, a bill ratifying the same was introduced in Congress on December 16, 1915, but was not finally ratified until April 1, 1918.

While the compact was pending in Congress, the Washington Legislature at its 1917 session made several changes in the existing fisheries law and contended they were effective because the compact agreement was not ratified by Congress until 1918, which then did not take recognition of the new regulations. When the matter came officially before the superior court of Pacific County, Wash., in 1919, the court held that the compact was valid, thus nullifying laws passed by the State of Washington affecting the Columbia River since 1915, and if this decision stands in the higher courts of both States all laws passed by either legislature since 1915, affecting the Columbia River fisheries, will fail unless they happen to be the same in both States.

WASHINGTON AND BRITISH COLUMBIA

The conditions which prevail in Puget Sound adjacent to the boundary between Washington and British Columbia have also been the cause of serious anxiety to those interested in the perpetuation of the salmon fisheries. The great schools of sockeye salmon which are on their way from the ocean to the spawning beds in the Fraser River pass through this section, and it is here that the greater part of the fishing is done. The Province of British Columbia and the State of Washington are vitally interested in the preservation of these fish.

The condition of affairs on Puget Sound and similar conditions in other boundary waters led the General Government to take up the matter, and on April 11, 1908, a convention was concluded between this country and Great Britain for the protection and preservation of the food fishes in international boundary waters of the United States and Canada. Both Governments appointed international commissioners—Dr. David Starr Jordan for the United States and S. T. Bastedo (who was succeeded later by Prof. Edward Ernest Prince) for Canada—whose duty it was to investigate conditions prevailing in these waters and to recommend a system of uniform and common international regulations. After an exhaustive investigation the commissioners submitted recommendations, which included the following affecting the boundary waters dividing the State of Washington and the Province of British Columbia, these waters being defined as the Strait of Juan de Fuca, and those parts of Washington Sound, the Gulf of Georgia, and Puget Sound lying between the parallels of 48° 10′ and 49° 20′:

GENERAL REGULATIONS

3. *Disposition of prohibited catch.*—In case any fish is unintentionally captured contrary to the prohibitions or restrictions contained in any of the following regulations, such fish shall, if possible, be immediately returned alive and uninjured to the water.

4. *Dynamite, poisonous substances, etc.*—No person shall place or use quicklime, dynamite, explosive, or poisonous substances, or electric device in treaty waters for the purpose of capturing or killing fish.

5. *Pollution of waters.*—No person shall place or pass, or allow to pass, into treaty waters any substance offensive to fishers, injurious to fish life, or destructive to fish fry or to the food of fish fry, unless permitted so to do under any law passed by the legislative authority having jurisdiction.

No person shall deposit dead fish, fish offal, or gurry in treaty waters, or on ice formed thereon, except in gurry grounds established by the duly constituted authorities.

6. *Capture of fishes for propagation or for scientific purposes.*—Nothing contained in these regulations shall prohibit or interfere with the taking of any fishes at any time for propagation or hatchery purposes, and obtaining at any time or by any method specimens of fishes for scientific purposes under authority granted for Canadian treaty waters by the duly constituted authorities in Canada and for United States treaty waters by the duly constituted authorities in the United States.

12. *Capture of immature salmon prohibited.*—No salmon or steelhead of less than 3 pounds in weight shall be fished for, killed, or captured in treaty waters.

13. *Salmon weirs, etc., above tidal limits prohibited.*—No salmon and no steelhead shall be fished for, killed, or captured by means of a net of any sort, any weir or any fish wheel, above tidal limits in any river in treaty waters.

14. *Close season for sturgeon.*—During the term of four years next following the date of the promulgation of these regulations no sturgeon shall be fished for, killed, or captured in treaty waters.

15. *Capture of fish for fertilizer or oil prohibited.*—Fishes useful for human food shall not be fished for, killed, or captured in treaty waters for use in the manufacture of fertilizer, or of oil other than oil for food or medicinal purposes.

16. Naked hooks and spears prohibited.—No spear, grappling hook, or naked hook, and no artificial bait with more than three hooks, or more than one burr of three hooks attached thereto, shall be used for the capture of fish in treaty waters. This regulation shall not prohibit the use of a gaff in hook-and-line fishing.

17. Torching prohibited.—No torch, flambeau, or other artificial light shall be used as a lure for fish in treaty waters.

The following regulations relate specifically to the waters named:

STRAIT OF JUAN DE FUCA AND ADJACENT WATERS

The following regulations (62 to 66, inclusive) shall apply to the Strait of Juan de Fuca, those parts of Washington Sound, the Gulf of Georgia, and Puget Sound lying between the parallels of 48° 10′ and 49° 20′ north latitude:

62. Close season for salmon.—From August 25 to September 15 in each year, both days inclusive, no salmon or steelhead shall be fished for, killed, or captured for commercial purposes in these treaty waters; provided, however, that in the waters to the westward of a line drawn southward from Gonzales Point to the shore of the State of Washington silver salmon, or coho salmon, may be fished for, killed, or captured from September 1 to September 15 in each year, both days inclusive.

63. Weekly close season for salmon and steelhead.—From 6 o'clock Saturday morning to 6 o'clock on the Monday morning next succeeding, no salmon or steelhead shall be fished for, killed, or captured in these treaty waters.

It is, however, provided that in the waters to the westward of a line drawn southward from Gonzales Point to the shore of the State of Washington the weekly close season shall begin 12 hours earlier, and shall end 12 hours earlier.

64. Construction of pound nets.—All pound nets or other stationary appliances for the capture of salmon or steelhead shall be so constructed that no fish whatever shall be taken during the weekly close season. The erection or addition to the pound net of a jigger is prohibited.

65. Location of pound nets.—All pound nets shall be limited to a length of 2,500 feet, with an end passageway of at least 600 feet between one pound net and the next in a linear series, such distance being measured in continuation of the line of direction of the leader of such net, and a lateral passageway of at least 2,400 feet between one pound net and the next.

On and after January 1, 1911, the mesh in pound nets shall be 4 inches in extension in the leader and not less than 3 inches in other parts of the net.

66. Nets other than pound nets.—No purse net shall be used within 3 miles of the mouth of any river and no seine within 1 mile of the mouth of any river in these treaty waters.

No gill net of more than 900 feet in length or of a greater depth than 60 meshes shall be used in these treaty waters.

The effort to enact these regulations into law by our Congress met with decided objections not only on the part of the Puget Sound operators, but also from operators in other waters affected, with the result that the bill was shelved and never acted upon finally. After waiting a while to see if any action would be taken by our Government, Canada finally repealed the act in which it had accepted the regulations.

DECREASE IN SOCKEYE SALMON RUN

In 1913 the matter of the Fraser River-Puget Sound sockeye salmon run came prominently to the fore through a rock slide in Hell Gate Canyon, on the Fraser River, caused by blasting operations of a construction gang building a railroad through there. This slide, it was asserted, cut off the greater part of the run to the upper river, and, it was feared, would have a very serious effect on future runs. By the time the run of 1914 arrived the greater part of the débris had been removed from the canyon, and the fish, it was alleged, could once more pass up. Reports of persons who visited these spawning grounds in 1913 and subsequent years were to the effect that but few spawners, as compared with earlier years, were to be found on them.

That the subsequent decrease in the runs was not to be attributed solely to the rock slide in Hell Gate Canyon is plainly evident by a glance at the pack figures in this area before and subsequent to 1913. The following statement shows the combined sockeye packs of the American and Canadian packers operating on the run going to the Fraser River:

	Cases		Cases
1909	[29] 1, 590, 555	1919	98, 409
1910	384, 869	1920	111, 053
1911	189, 767	1921	[29] 142, 598
1912	307, 775	1922	100, 398
1913	[29] 2, 401, 488	1923	79, 057
1914	534, 434	1924	109, 112
1915	155, 714	1925	[29] 147, 408
1916	105, 870	1926	130, 362
1917	[29] 559, 732	1927	158, 987
1918	70, 420		

Aside from the damage caused to the "big year" run by the rock slide, there can be only one explanation of such a progressive decline in the pack, and that is excessive fishing. The fishermen of both countries are to blame for this. On the American side traps, purse seines, and, in a slight degree, gill nets, have taken a heavy toll of the fish as they passed through our waters. After some had safely run this gantlet they met thousands of gill nets operated by Canadian fishermen in and around the mouth of the Fraser River and in the lower reaches of same, and it is a wonder that any of the schools ever got to the spawning beds. Several abortive attempts have been made by the authorities of Canada and British Columbia on the one side and the State of Washington on the other to arrive at some equitable method for protecting this sockeye run. The former especially have professed an earnest desire to do something along this line, and there is no reason to doubt their sincerity. On the American side a few people, and among these a few of the more intelligent canners, pleaded for the enactment of laws that would adequately protect the salmon, but they were overborne by the great bulk of the packers and fishermen who, disregarding all the warnings and teachings of experience, insisted upon going ruthlessly forward with the slaughter, and when reproached with their shortsightedness clamored for the establishment of more salmon hatcheries, as though the latter could accomplish the miracle of increasing the supply of fry from a steadily decreasing supply of eggs.

That this wanton destruction of one of our greatest natural resources should have been permitted to continue unchecked by the people of Washington and British Columbia is a most surprising thing, and indicates either a most remarkable ignorance of the condition, which should have been patent to everybody, or a criminal apathy.

AMERICAN-CANADIAN FISHERIES CONFERENCE

In 1917 a joint commission, known as the American-Canadian Fisheries Conference, was appointed to take evidence and see if it were possible to compose the fishery disputes which had affected the good relations of the two countries for over 150 years. The commission was composed, for America, of William C. Redfield, Secretary of Commerce; Edwin F. Sweet, Assistant Secretary of Commerce; and

[29] The big year, which comes every fourth year.

Dr. Hugh M. Smith, Commissioner of Fisheries; and for Canada, of J. Douglas Hazen, Chief Justice of New Brunswick, who had been for six years Minister of Marine and Fisheries for Canada; George G. Desbarats, Deputy Minister Naval Service; and William A. Found, Superintendent of Fisheries.

Hearings were held on the Atlantic coast in 1917 and on the Pacific coast in 1918, and in 1919 the commission agreed upon and presented to their respective Governments serveral treaties concerning these matters, the only one of special interest here being the treaty covering the sockeye fisheries of the Fraser River-Puget Sound, which was signed on September 2, 1919. Owing to its importance this treaty is reproduced entire below:

CONVENTION FOR THE PROTECTION, PRESERVATION, AND PROPAGATION OF SALMON

The United States of America, and His Majesty George V, of the United Kingdom of Great Britain and Ireland, and of the British Dominions beyond the Seas, King, Emperor of India, equally recognizing the desirability of uniform and effective measures for the protection, preservation, and propagation of the salmon fisheries in the waters contiguous to the United States and the Dominion of Canada, and in the Fraser River System, have resolved to conclude a convention for this purpose, and have named as their Plenipotentiaries:

The President of the United States of America, the Honorable Robert Lansing, Secretary of State of the United States of America, and

His Britannic Majesty, the Honorable Ronald Lindsay, his charge d'affaires at Washington, and the Honorable Sir John Douglas Hazen, a Knight Commander of the Most Distinguished Order of St. Michael and St. George, Chief Justice of New Brunswick, and a member of his Privy Council for Canada.

Who, having exhibited their full powers, found to be in due form, have agreed to and signed the following articles:

Article I

The times, seasons, and methods of sockeye-salmon fishing in the waters specified in Article III of this Convention, and the nets, engines, gear, apparatus, and appliances which may be used therein, shall be limited to those which are specified in the regulations appended hereto, and/or which may be specified in revised, modified, or substituted regulations provided for in Article VI and promulgated in accordance with the terms of Article II.

Article II

The High Contracting Parties engage to put into operation and enforce by legislative and executive action, with as little delay as possible, the provisions of this convention and said regulations, and the date when the said regulations shall be put into operation, shall be fixed by concurrent proclamations of the President of the United States and of the Governor General of the Dominion of Canada in Council. Each of the High Contracting Parties may, by appropriate legislation, provide for the trial, conviction, and punishment within its jurisdiction of any person found there who has contravened any of the provisions of this convention, and/or said regulations within the jurisdiction of the other High Contracting Party and who has not been punished for such offence within the latter jurisidiction.

Article III

It is agreed that the provisions of this convention and of said regulations shall apply to the waters included within the following boundaries:

Beginning at Carmanagh Lighthouse on the southwest coast of Vancouver Island, thence in a straight line to a point three marine miles due west astronomic from Tatoosh Lighthouse, Washington, thence to said Tatoosh Lighthouse, thence to the nearest point of Cape Flattery, thence following the southerly shore of Juan de Fuca Strait to Point Wilson, on Quimper Peninsula, thence in a straight line to Point Partridge on Whidbey Island, thence following the western shore of the said Whidbey Island, to the entrance to Deception Pass, thence across said entrance to the southern side of Reservation Bay, on Fidalgo

Island, thence following the western and northern shore line of the said Fidalgo Island to Swinomish Slough, crossing the said Swinomish Slough in line with the track of the Great Northern Railway, thence northerly following the shore line of the mainland to Point Grey at the southern entrance to Burrard Inlet, British Columbia, thence in a straight line to the southern end of Gabriola Island, thence to the southern side of the entrance to Boat Harbor, Vancouver Island, thence following the eastern and southern shores of the said Vancouver Island to the starting point at Carmanagh Lighthouse, as shown on the United States Coast and Geodetic Survey Chart No. 6300, as corrected to July 20, 1918, and also the Fraser River and its tributaries.

The High Contracting Parties engage to have prepared, as soon as practicable, charts of the waters described in this article, with the international boundary line indicated thereon; and to establish such buoys and marks for the purposes of this convention as may be recommended by the commission referred to in Article IV.

Article IV

The High Contracting Parties agree to appoint, within two months after the exchange of ratifications of this convention, a commission to be known as the International Fisheries Commission, consisting of four persons, two to be named by each party. This commission shall continue to exist so long as this convention shall be in force. Each party shall have the power to fill, and shall fill, from time to time, any vacancy which may occur in its representation on the commission. Each party shall pay its own commissioners, and any joint expenses shall be paid by the two High Contracting Parties in equal moieties.

Article V

The International Fisheries Commission shall conduct investigations into the ife history of the salmon, hatchery methods, spawning-ground conditions, and other related matters, and shall observe the operation of the said regulations appended hereto, and shall recommend to their respective Governments any modifications of, additions to, or substitutions for the appended regulations which may be found desirable.

Article VI

The regulations appended to this convention shall remain in force for a period of eight years from the date of their promulgation, as provided in Article II, and thereafter until one year from the date when either of the High Contracting Parties shall give notice to the other of its desire for their revision, or until the termination of this convention, whichever shall first occur. Immediately upon such notice being given, the International Fisheries Commission shall proceed to make a revision of said regulations, which revised regulations shall be incorporated in a special agreement between the High Contracting Parties. It is understood that such special agreement shall on the part of the United States be made by the President of the United States, by and with the advice and consent of the Senate thereof. Such special agreement shall be binding only when confirmed by the two Governments by an exchange of notes. Such special agreement shall be promulgated as provided in Article II hereof, and shall remain in force for a period of five years and thereafter until one year from the date when a further notice of revision is given as above provided in this article, or until the termination of this convention, whichever shall first occur.

It shall, however, at any time, be in the power of the High Contracting Parties by special agreement upon the recommendation of the International Fisheries Commission, to make modifications of, additions to, or substitutions for any of the regulations in force, and (or) to make the provisions of this convention, and any regulations promulgated in accordance with the terms thereof, operative in the waters specified in Article III of this convention, as to any or all of the other species of salmon, including steelhead. It is understood that such special agreement shall on the part of the United States be made by the President of the United States, by and with the advice and consent of the Senate thereof. Such special agreement shall be binding only when confirmed by the two Governments by an exchange of notes. Such special agreement shall be promulgated as provided in Article II hereof.

Article VII

This convention shall remain in force for a period of fifteen years, and thereafter until two years from the date when either of the High Contracting Parties shall give notice to the other of its desire to terminate this convention.

Article VIII

The present convention shall be duly ratified by the President of the United States, by and with the advice and consent of the Senate thereof, and by His Britannic Majesty, and the ratifications shall be exchanged at Washington as soon as practicable.

IN FAITH WHEREOF, the respective plenipotentiaries have signed the present convention in duplicate and thereunto affixed their seals.

Done at the City of Washington this second day of September, in the year one thousand nine hundred and nineteen.

ROBERT LANSING, (Seal)
R. C. LINDSAY, (Seal)
J. D. HAZEN. (Seal)

APPENDIX

INTERNATIONAL REGULATIONS FOR THE PROTECTION AND PRESERVATION OF THE SOCKEYE SALMON FISHERIES OF THE FRASER RIVER SYSTEM

Section 1

The following regulations shall apply to the waters described in Article III of the convention of September 2, 1919, between the United States and Great Britain, to which these regulations are appended, to-wit:

(Here is inserted the description of the waters affected, as already set forth in Article III above.)

Section 2

DEFINITIONS

"Drift net" shall mean a floating gill net that is neither anchored nor staked, but that floats freely with the tide or current.

"Trap net" shall include a pound net.

"Commission" shall mean the International Fisheries Commission appointed under the convention to which these regulations are appended.

"Treaty waters" shall mean all waters described in Article III of the convention to which these regulations are appended.

Section 3

(*a*) Fishing for sockeye salmon in the treaty waters within the territorial limits of the State of Washington, shall not be permissible except under license from such state, and in the treaty waters of Canada except under license under the provisions of the fisheries act of Canada.

(*b*) No greater number of licenses for any class of fishing appliance shall be authorized in any year in the treaty waters within the territorial limits of the State of Washington than were issued for such class for the season of 1918, up to August 31st, inclusive thereof, and in the treaty waters of Canada the number of gill nets that may be licensed in any year shall not exceed 1,800.

(*c*) No license shall be granted to any person or partnership in the State of Washington unless such person or each member of such partnership shall be an American citizen, resident in said State, and no license shall be granted to any joint-stock company or corporation in said State, unless the officers, directors and the holders of a majority of the stock thereof, are American citizens, or unless it is authorized to do business in the said State; and no license shall be granted to any person, company or firm in the Province of British Columbia unless such person is a British subject resident in the said Province, or unless such company or firm is a Canadian company or firm, or is authorized by the Provincial Government to do business in the said Province of British Columbia.

(*d*) No one other than a British subject who owns or leases land on either side of the Fraser River above New Westminster Bridge, and who actually permanently resides on, and is cultivating such land, shall be eligible for a license to fish for sockeye salmon between New Westminster Bridge and Mission Bridge, but fishing under such license shall not be carried on below New Westminster Bridge.

Section 4

The use of nets other than drift nets, purse seines, and trap nets shall not be permitted in treaty waters for the capture of sockeye salmon.

Section 5

No net fishing or fishing of any kind, other than with hook and line, except for hatchery purposes, or scientific purposes, shall be permissible in the Fraser River above the down river side of Mission Bridge.

Section 6

During the years 1920 to 1927, both years inclusive, no one shall fish for, catch or kill any salmon from the 20th day of July to the 31st day of July in each year, both days inclusive; and during this close time, no nets or appliances of any kind that will capture salmon may be used in these treaty waters; *Provided, however,* That salmon fishing for hatchery or scientific purposes may be authorized during this period.

Section 7

The weekly close time for salmon fishing shall be from six o'clock a. m. Saturday to six o'clock p. m. Sunday, in Canadian waters, excepting in that portion of the Fraser River between New Westminster Bridge and Mission Bridge, where the weekly close time shall be from six o'clock a. m. Saturday to six o'clock p. m. on the following Monday, and in the treaty waters of the United States from Friday at four o'clock p. m. to Sunday at four o'clock a. m. and during this close time no salmon fishing of any kind other than for hatchery or scientific purposes shall be permissible, and during the full period of each weekly close time or annual close season, each trap net shall be closed by an apron across the outer entrance to the heart of the trap, which apron shall extend from the surface to the bottom of the water and shall be securely connected to the piles on either side of the heart of the trap net, fastened by rings not more than two feet apart on taut wires stretched from the top to the bottom of the piles, and such apron, or the appliance by which it is raised and lowered, shall be provided with a signal or flag, which shall disclose whether the trap net is closed, and which shall be of the form and character approved by the commission: *Provided,* that in addition to the foregoing requirement, such trap net shall be equipped with a V-shaped opening, to the satisfaction of the commission, and in the lead of such trap net next to the entrance to the heart and immediately adjacent to the apron, of at least ten feet in width at the top and extending below the surface at least four feet below low water, which V-shaped opening shall remain open and unobstructed during the full period of each weekly close time or annual close season. For the purposes of assuring full compliance with this regulation, the owner or operator of each trap net shall constantly maintain during the weekly and annual close time a watchman, whose duty it shall be to cause each trap net to be kept closed and the lead to be kept open, as above provided.

Section 8

All salmon trap nets shall be limited to a total length of twenty-five hundred feet, with an end passageway of at least six hundred feet between one trap net and the next in linear series, such distances being measured in continuation of the line of direction of the leader of such trap net, but in no instance shall more than two-thirds of the width of any passageway at any point be closed by trap nets. There shall also be a lateral distance of at least twenty-four hundred feet between one trap net and the next.

Section 9

A salmon purse seine shall not exceed nineteen hundred linear feet in length, including the lead and attachment, measured on the cork line when wet.

Section 10

(*a*) No purse seine shall be cast or placed in the water for fishing purposes within twenty-four hundred feet of any trap net.

(*b*) The use of purse seines for the capture of sockeye salmon shall be confined to the treaty waters southward and westward of a straight line drawn from the lighthouse on Trial Island, British Columbia, to the northwest point of Whidbey Island, State of Washington.

Section 11

A salmon drift net shall not exceed nine hundred linear feet in length, and the vertical breadth thereof shall not exceed sixty meshes, and the size of the mesh shall not be less than five and three-fourths inches, extension measure, when in use.

Had such a treaty been adopted and rigidly enforced 10 or 12 years ago,[30] it might have had a beneficial effect on the Fraser River-Puget Sound sockeye run, but the destruction of the run has progressed to such an alarming extent during the past 7 years that only a total cessation of all fishing for sockeyes in this section for a term of years could have the slightest beneficial effect. The proposed regulations provide that "during the years 1920 to 1927, both years inclusive, no one shall fish for, catch, or kill any salmon from the 20th day of July to the 31st day of July in each year, both days inclusive; and during this close time no nets or appliances of any kind that will capture salmon may be used in these treaty waters * * *." This closed period runs concurrently on both sides of the line, and while it would have but a very slight effect if the salmon were able to reach the spawning grounds in this short period, it certainly can have none if the Canadian gill netters are enabled to start fishing just about the time the salmon have reached the mouth of the Fraser.

The only hope of rehabilitating the sockeye run—and some well-informed observers have grave doubts whether anything will ever accomplish this desirable result—is to close the waters of Puget Sound through which the sockeyes pass and the Fraser River during the months of July and August or such other period as may be necessary to protect the sockeyes from the time they appear off the capes until they have passed beyond the fishermen on the Fraser River to all salmon fishing for a period of 8 or 12 years. As the sockeyes are 4-year fish—i. e., are born and live in fresh water for about a year, then go to sea, and are not observed again until they return in the fourth year after birth (a small proportion live to 5 years, and a vastly smaller proportion to 6 years), spawn on the breeding grounds of the Fraser and then die—a closed period of less than 4 years could have no appreciable effect, as it would not be a complete cycle in the animal's life, while 8 or 12 years, representing two or three cycles of their life, might possibly have a beneficial effect, although the experiences of the past show clearly that it is much easier to destroy a school of fish than it is to restore a much depleted one.

NEW TREATY PROPOSED

On April 18, 1929, a convention between the United States and Great Britain, looking to the protection, preservation, and extension of the sockeye-salmon fisheries in the Fraser River system, signed at Washington on March 27, 1929, was transmitted by President Hoover to the United States Senate for its action. The convention reads as follows:

PRESERVATION AND EXTENSION OF THE SOCKEYE SALMON FISHERIES IN THE FRASER RIVER SYSTEM

The President of the United States of America and His Majesty the King of Great Britain, Ireland and the British Dominions beyond the Seas, Emperor of India, recognizing that the protection, preservation and extension of the sockeye salmon fisheries in the Fraser River system are of common concern to the United States of America and the Dominion of Canada; that the supply of this fish in recent years has been gravely depleted and that it is of the utmost importance in the mutual interest of both countries that this source of wealth should be restored and maintained, have resolved to conclude a convention and to that end have named as their respective plenipotentiaries;

The President of the United States of America:

[30] This and the succeeding paragraph were written in 1919 and the need for such action is even more imperative to-day (1929).

Mr. Frank B. Kellogg, Secretary of State of the United States of America; and His Majesty, for the Dominion of Canada:

The Honourable Charles Vincent Massey, P. C., His Envoy Extraordinary and Minister Plenipotentiary for Canada at Washington;

Who, after having communicated to each other their full powers, found in good and due form, have agreed upon the following Articles:

Article I

The provisions of this Convention and the regulations issued pursuant thereto shall apply to the Fraser River and the streams and lakes tributary thereto and to all waters frequented by sockeye salmon included within the following boundaries:

Beginning at Carmanah Lighthouse on the southwest coast of Vancouver Island, thence in a straight line to a point three marine miles due west astronomic from Tatoosh Lighthouse, Washington, thence to said Tatoosh Lighthouse, thence to the nearest point of Cape Flattery, thence following the southerly shore of Juan de Fuca Strait to Point Wilson, on Quimper Peninsula, thence in a straight line to Point Partridge on Whidbey Island, thence following the western shore of the said Whidbey Island, to the entrance to Deception Pass, thence across said entrance to the southern side of Reservation Bay, on Fidalgo Island, thence following the western and northern shore line of the said Fidalgo Island to Swinomish Slough, crossing the said Swinomish Slough, in line with the track of the Great Northern Railway, thence northerly following the shore line of the mainland to Atkinson Point at the northerly entrance to Burrard Inlet, British Columbia, thence in a straight line to the southern end of Bowen Island, thence westerly following the southern shore of Bowen Island to Cape Roger Curtis, thence in a straight line to Gower Point, thence westerly following the shore line to Welcome Point on Seechelt Peninsula, thence in a straight line to Point Young on Lasqueti Island, thence in a straight line to Dorcas Point on Vancouver Island, thence following the eastern and southern shores of the said Vancouver Island to the starting point at Carmanah Lighthouse as shown on the United States Coast and Geodetic Survey Chart Number 6300, as corrected to October 20, 1924, and on the British Admiralty Chart Number 579.

The High Contracting Parties engage to have prepared as soon as practicable charts of the waters described in this Article, with the above described boundaries and the International boundary line indicated thereon. They further agree to establish within the territory of the United States and the territory of the Dominion of Canada such buoys and marks for the purposes of this Convention as may be recommended by the Commission hereinafter authorized to be established, and to refer such of these recommendations as relate to points on the boundary to the International Boundary Commission, United States-Alaska and Canada, for action pursuant to the provisions of the Treaty respecting the boundary between the United States and Canada signed February 24, 1925.

Article II

The High Contracting Parties agree to establish and maintain a Commission to be known as the International Pacific Salmon Fisheries Commission, hereinafter called the Commission, consisting of six members, three on the part of the United States of America, and three on the part of the Dominion of Canada.

The Commissioners on the part of the United States shall be appointed by the President of the United States, and the Commissioner of Fisheries of the United States shall be one of them. The Commissioners on the part of the Dominion of Canada shall be appointed by His Majesty on the recommendation of the Governor-General-in-Council.

The Commission shall continue in existence so long as this Convention shall continue in force, and each High Contracting Party shall have power to fill and shall fill from time to time vacancies which may occur in its representation on the Commission in the same manner as the original appointments are made. Each High Contracting Party shall pay the salaries and expenses of its own Commissioners, and the joint expenses incurred by the Commission shall be paid by the two High Contracting Parties in equal moieties.

Article III

The Commission shall make a thorough investigation into the natural history of the Fraser River sockeye salmon, into hatchery methods, spawning ground conditions and other related matters. It shall conduct the sockeye salmon fish cultural operations in the area described in Article I, and to that end it shall have power to improve spawning grounds, acquire, construct and maintain hatcheries, rearing ponds and other such facilities as it may determine to be necessary for the propagation of sockeye salmon in the water covered by this Convention, and to stock the waters with sockeye salmon by such methods as it may determine to be most advisable. The Commission shall also have authority to recommend to the two Governments the removal of obstructions to the ascent of sockeye salmon in the waters covered by this Convention, that may now exist or may from time to time occur, and to improve conditions for the ascent of sockeye salmon, where investigation may show such to be desirable. The Commission shall report annually to the two Governments what it has accomplished and the results of its investigations.

The cost of all such work shall be borne equally by the two Governments, and the said Governments agree to appropriate annually such money as each may deem desirable for such work in the light of the reports of the Commission.

Article IV

The International Salmon Fisheries Commission established pursuant to Article II of this Convention is hereby empowered, between the first day of June and the twentieth day of August in any year, for the whole or any part of the aforesaid period, to limit or prohibit the taking of sockeye salmon in respect of all the waters described in Article I of this Convention, or in respect of waters of the United States and Canadian waters separately, provided, that when any order is adopted by the Commission limiting or prohibiting the taking of sockeye salmon in regard to waters of the United States or Canadian waters separately, it shall extend to all of the waters of the United States or Canadian waters to which this Convention applies, and Provided further, that no order limiting or prohibiting the taking of sockeye salmon adopted by the International Salmon Fisheries Commission shall be construed to suspend or otherwise affect the requirements of the laws of the State of Washington or of the Dominion of Canada as to the procuring of a license to fish in the waters on their respective sides of the boundary line. Any order adopted by the Commission limiting or prohibiting the taking of sockeye salmon in said waters during said period, or any part thereof, shall remain in full force and effect unless and until the same be modified or set aside by the Commission. The taking of sockeye salmon in said waters during said period in violation of the orders of the Commission adopted from time to time is hereby prohibited.

Article V

In order to secure a proper escapement of sockeye salmon during the spring or chinook salmon fishing season, the International Salmon Fisheries Commission may prescribe the size of the meshes in all fishing gear and appliances operated in the waters described in Article I of this Convention which are frequented by sockeye salmon.

Whenever the taking of sockeye salmon in said waters during said period between the first of June and the twentieth of August in any year is permitted under the orders adopted by the Commission in respect of waters of the United States, any fishing appliance legally authorized by the State of Washington may be used in such waters by any person thereunto authorized by that State, and whenever the taking of sockeye salmon in said waters during said period is permitted under the orders adopted by the Commission in respect of Canadian waters any fishing appliances authorized by the laws of the Dominion of Canada may be used in such waters by any person thereunto legally authorized.

Article VI

No action taken by the Commission under the authority of Articles IV and V of this Convention shall be effective unless it is affirmatively voted for by at least two of the Commissioners from each country.

Article VII

Inasmuch as the purpose of this Convention is to establish for the High Contracting Parties, by their joint effort and expense, a fishery that is now largely nonexistent, each of the High Contracting Parties should share equally in the fishery. The Commission shall, consequently, in regulating the fishery do so with the object of enabling, as nearly as they can, an equal portion of the fish that is allowed to be caught each year to be taken by the fishermen of each High Contracting Party.

ARTICLE VIII

Each High Contracting Party shall be responsible for the enforcement of the regulations provided by the Commission in the portion of their respective waters covered by the Convention, and to this end they agree to enact and enforce such legislation as may be necessary to make effective the provisions of this Convention, with appropriate penalties for violations thereof.

ARTICLE IX

The present Convention shall be ratified by the President of the United States of America, by and with the advice and consent of the Senate thereof, and by His Majesty in accordance with constitutional practice, and it shall become effective upon the date of the exchange of ratifications which shall take place at Washington as soon as possible and shall continue in force for a period of sixteen years, and thereafter until one year from the day on which either of the High Contracting Parties shall give notice to the other of its desire to terminate it.

In witness whereof, the respective plenipotentiaries have signed the present Convention, and have affixed their seals thereto.

Done in duplicate at Washington, the twenty-seventh day of March, one thousand nine hundred and twenty-nine.

[SEAL] FRANK B. KELLOGG
[SEAL] VINCENT MASSEY

PACKS BY CANADIAN AND AMERICAN CANNERS

Many people on both sides of the boundary line have been under the impression that the American fishermen on Puget Sound have been by far the greatest offenders in so far as the quantity of sockeye salmon taken has been concerned, but a table [31] prepared by Mr. J. P. Babcock, assistant to the Commissioner of Fisheries of British Columbia, for the years 1891 to 1919 and by the author, from various sources, for 1920 to 1927, does not bear this out entirely. Previous to 1891 most of the fishing was done by British Columbia fishermen. The table follows:

Year	Canadian waters	American waters	Total	Year	Canadian waters	American waters	Total
	Cases	*Cases*	*Cases*		*Cases*	*Cases*	*Cases*
1891	176, 954	5, 538	182, 492	1910	150, 432	234, 437	384, 869
1892	79, 715	2, 954	82, 669	1911	62, 817	126, 950	189, 767
1893	457, 797	47, 852	505, 649	1912	123, 879	183, 896	307, 775
1894	363, 967	41, 791	405, 758	1913	736, 661	1, 664, 827	2, 401, 488
1895	395, 984	65, 143	461, 127	1914	198, 183	336, 251	534, 434
1896	356, 984	72, 979	429, 963	1915	91, 130	64, 584	155, 714
1897	860, 459	312, 048	1, 172, 507	1916	27, 394	78, 476	105, 870
1898	256, 101	252, 000	508, 101	1917	148, 164	411, 538	559, 702
1899	480, 485	499, 646	980, 131	1918	19, 697	50, 723	70, 420
1900	229, 800	228, 704	458, 504	1919	34, 063	64, 346	98, 409
1901	928, 669	1, 105, 096	2, 033, 765	1920	48, 399	62, 654	111, 053
1902	293, 477	339, 556	633, 033	1921	39, 631	102, 967	142, 598
1903	204, 809	167, 211	372, 020	1922	51, 832	48, 566	100, 398
1904	72, 688	123, 419	196, 107	1923	31, 655	47, 402	79, 057
1905	837, 489	847, 122	1, 684, 611	1924	39, 743	69, 369	109, 112
1906	183, 007	182, 241	365, 248	1925	35, 385	112, 023	147, 408
1907	62, 617	96, 974	159, 591	1926	85, 689	44, 673	130, 362
1908	74, 574	155, 218	229, 792	1927	61, 393	97, 594	158, 987
1909	585, 435	1, 005, 120	1, 590, 555				

[31] Fraser River Salmon Situation: A Reclamation Project. By John Pease Babcock. Appendix V, Report, British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1919, p. 3. Victoria, British Columbia, 1920.

METHODS OF PREPARING SALMON

CANNING

EARLY DAYS OF THE INDUSTRY

In the salmon industry canning is and has been almost from the time of the discovery of a feasible method of so preserving the fish, the principal branch. The first canning of salmon on the Pacific coast was on the Sacramento River in 1864, when G. W. and William Hume and Andrew S. Hapgood, operating under the firm name of Hapgood, Hume & Co., started the work on a scow at Washington, Yolo County, Calif. The Hume brothers, who came from Maine originally, had been fishing for salmon in the Sacramento River for some years before the idea of canning the fish had entered their minds, while Mr. Hapgood had previously been engaged in canning lobsters in Maine, and was induced by the Humes to participate in order that they might have the benefit of his knowledge of canning methods. The late R. D. Hume, who worked in the original cannery and later became one of the best-known canners on the coast, thus describes the plant and the methods employed: [32]

Before the arrival of Mr. Hapgood (from Maine) the Hume brothers had purchased a large scow, on which they proposed to do the canning of salmon, and had added an extension to the cabin 18 by 24 feet in area, to be used as a can-making shop. This had a shed on the side next to the river for holding any cans that might be made in advance of the packing season. A few days after the arrival of Mr. Hapgood (March 23, 1864), the tools and machinery were packed and put in position. Mr. Hapgood made some stovepipe and two or three sheet-iron fire pots, and in a short time was ready for can making. The following list of tools and machinery will show how primitive our facilities were as compared with present methods: 1 screw hand press, 1 set cast-iron top dies, 1 set cast-iron bottom dies, 1 pair squaring shears, 1 pair rotary shears, 1 pair bench shears, 1 pair hand shears or snips, 1 pair 24-inch rolls, 1 anvil (weight 50 pounds), 1 forging hammer, 1 tinner's hammer, 1 set punches for making stovepipe, 1 rivet set, 1 grooving set, 2 iron slabs grooved on one side to mold strips of solder, 1 iron clamp to hold bodies of cans while soldering the seams, 1 triangular piece of cast iron about three-eighths of an inch in thickness and 6 inches in length, with a wooden handle attached to the apex, also used for holding can bodies in place while being seamed.

The process of canning was as follows: The bodies of the cans were first cut to proper size by the squaring shears, a line was then scribed with a gauge about three-sixteenths of an inch from one edge, and they were next formed into cylindrical shape by the rolls. They were then taken to the soldering bench and one edge lapped by the other until the edge met the line that had been scribed and fastened there by being soldered a small part of the length to hold them in place for the further purpose of seaming. They were then placed either in the iron clamp, which had a piece of wood attached to its underside, and held firmly, the clamp being closed by the operation of a treadle, or were slipped on a piece of wood, which was bolted to the bench, while being held in place by the triangular hand seamer, which was pressed down on the lap of the seam by the left hand of the operator. When this had been done a piece of solder, which had been prepared by shaking in a can together with rosin, was placed on the seam and melted and rubbed lengthwise of the seam. After cooling the bodies were ready for the end or bottom, which operation was brought about by first cutting out circular blanks with the rotary shears, and then placing them in the cast-iron die and bringing the handle of the screw press around with a swing with force enough to form up the end or bottom. In this operation there were many difficulties, as the ends or bottoms would many times stick to the upper part of the die and refuse to come off, and finger nails were pretty short in those days. To get the ends out of the lower part of the die was not so bad,

[32] The First Salmon Cannery. By R. D. Hume. Pacific Fisherman, Vol. II, No. 1, January, 1904, pp. 19–21.

FIG. 26.—SALMON CANNERY AT HOONAH, ALASKA

FIG. 27.—SALMON CANNERY AT SANTA ANA, ALASKA

as a wooden plunger operated by a treadle knocked them out, but sometimes they were in pretty bad shape. When the bottoms or ends were ready they were slipped on the bodies and the edge of the bottom rolled about in a pan of powdered rosin until the seam was well dusted. A piece of solder similar in size and preparation as used for the side seam was placed in the can. They were then placed on the smooth side of the cast-iron slabs, and the operator, with a hot soldering copper shaped to fit the circle of the can, melted the solder and by turning the can rapidly soldered the full circumference. The output of this can factory was very imperfect, as at least one-half of the seams burst, owing to the lack of experience of the manager or want of good judgment.

When the can making was well underway Mr. Hapgood then turned his attention to getting the apparatus for canning on board the house-boat. This in the cooking department consisted of a kettle made of boiler iron about 36 inches in diameter and 5 feet in depth, set in a brick furnace and fired from underneath. Alongside was a round-bottom, cast-iron pot holding about 60 gallons of water and heated in the same manner. These kettles, with a dozen coolers or circular sheet-iron pans with ropes attached and with holes cut in the bottoms for drainage, a set of 5-inch blocks and tackle, with a sheet-iron fire pot and a scratch awl, completed the bathroom outfit. The can filling and soldering room was furnished with a table through the center, where cutting the salmon in pieces to suit and the filling of the cans was done. On each side of the room there was a bench running the full length, on the end of one of which the cans were placed to receive the pickle, which was used at that time instead of the small quantity of salt that is placed in the cans during the operations of these later days. After the salmon had been cleaned by removing the entrails and washing them outside the covered portion of the scow, they were brought inside and placed on the table, and a man with a butcher knife in one hand and a stick in the other, which had a mark showing the length of the pieces desired, cut gashes in the side of the salmon as a guide and then cut the fish into sections corresponding to the length of the mark on the stick. He then proceeded to cut the sections in pieces to suit the cans. Then three or four operators placed the salmons in the cans and shoved them along the table to where a boy wiped the top edge and passed them along to two others who placed tops which fitted inside of the rim. The cans were then taken in wooden trays to the bench opposite the starting point, which was fitted with four sheet-iron pots, and at the one nearest the entrance to the house on the scow a man put a soldering flux on the top edge, which was made by adding zinc to muriatic acid, and then with a pointed soldering copper and a stick of solder melted the solder until a small portion could be drawn around the groove formed by the edge of the can and the bevel of the top. From there the cans were taken to the other parts of the bench, where two men finished soldering the head in, and then taken to the third man, who soldered, or, as it was called, buttoned, the end of the seam lap. The cooking department or bathroom, as it was called, was separated from the filling and soldering room by a partition. The cans were shoved through a hole in the partition.

At this time the process was a secret. Mr. Hapgood did the cooking and all the work done inside, no one but a member of the firm being allowed to go in. This privacy was continued until the firm moved to the Columbia River, and, the labor becoming too arduous for Mr. Hapgood to perform alone, a boy by the name of Charlie Taylor was taken in as an assistant. * * *

But to return to the original proposition: When the filled cans had been soldered and entered the bathroom they were put in the coolers and lowered into the cast-iron pot, one cooler of cans being cooked at a time. The cooler was lowered into the boiling fresh water until the cans were submerged to within 1 inch of the top ends and left to cook for one hour; then they were hoisted out and the vent holes in the center of the top soldered up, after which they were dumped into the boiler-iron kettle, which held a solution of salt and water of density sufficient to produce, when boiling, a heat of 228° to 230° F. They were cooked in this solution for one hour and then taken out of the kettle with an iron scoop shaped like a dip net, with a wooden handle about 6 feet in length. They were dumped into a tank of water on the other side of the partition which separated the bathroom from the packing room through an opening in the partition, receiving many a bump and bruise in the operation. Then they were washed with soap and rag to remove the dirt and grease, each can being handled separately. When this was done they were piled on the floor of the packing room and in a few days were painted with a mixture of red lead, turpentine, and linseed oil, for at that time buyers would have no canned salmon, no matter how good the quality, unless the cans were painted red.

When packs of 10,000 to 15,000 cases were made in a season only the absolutely essential machinery was used, the rest of the work, such as cutting and cleaning the fish and placing them in the cans, being done by hand. When larger canneries were constructed, especially in Alaska, where labor is expensive and difficult to obtain, the greater part of the workmen having to be brought up from the States, machinery to do as much as possible of the work became absolutely essential. The inventive genius of the country came to the rescue and one by one machines for cutting, sliming, and cleaning the fish, filling the cans, putting the tops on, and washing them were invented and put into use, while automatic weighing machines were produced and extensive improvements and alterations were made in the machines previously in use. There are to-day many large manufacturing establishments which devote all or the greater part of their facilities to furnishing machinery and supplies to this giant branch of the salmon industry.

When salmon canning was in its infancy, a pack of from 150 to 200 cases was considered a good day's work. Now it is not an uncommon occurrence for a cannery to turn out from 2,500 to 4,000 cases in one day, and there are a number which have even greater capacity.

The usual method of figuring the capacity of a salmon cannery is by the number of lines or units employed. The machinery arranged so that the fish pass through all the operations from filling to double seaming is known as a line, and the capacity is based upon the number of these lines in use in the plant.

During the height of the salmon run, a cannery is an exceedingly busy and interesting place, and a description of the methods used at the present time will show the giant strides the industry has made since the days of Hapgood, Hume & Co.

HANDLING THE SALMON

At convenient spots near the fishing grounds large scows and lighters are anchored and the fishing crews deliver their catches aboard these, the tallyman on each scow keeping a record and giving the crew a receipt. Men fishing near the cannery deliver their catch alongside. Steamers and launches are used to tow out empty scows and bring in those filled. In the old days the fish were pitched by hand into bins on the wharves, but this laborious method has been superseded by the use of an elevator, which extends from a short distance above the top of the wharf to the water's edge, provision being made for raising or lowering the lower end according to the stage of the tide. This elevator is slanting, and is made of an endless chain operating in a shallow trough. About every 2 feet there is attached to the chain a crosspiece of wood. At the top of the elevator are chutes which deliver the fish at various convenient spots on the cutting-room floor.

A comparatively recent invention is the unloading scow. This is a scow divided by kid boards into compartments. On the side is an opening which, when not in use, is closed by planks dropped into grooves. The filled scow is run alongside an elevator with a flaring mouth box at the lower end. A chute is placed between the scow, opposite the door, and the elevator, the door opened, and the fish allowed to slide by gravity into the box, then up the elevator to the fish floor. As one compartment is emptied another is attacked by

FIG. 28.—A BATTERY OF "IRON CHINKS"

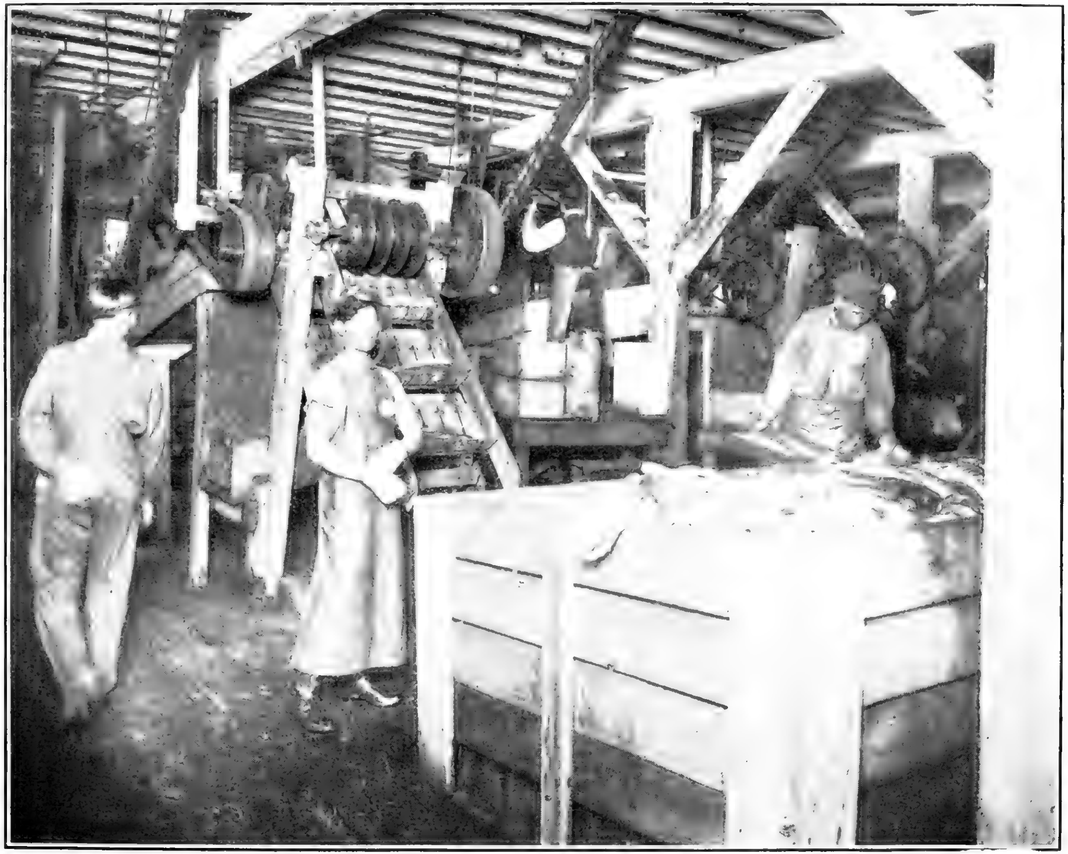

FIG. 29.—CUTTING SALMON INTO PIECES OF A SIZE TO FIT HE CAN

removing the partition boards, and so on until the scow is empty. Should the fish stick, a hose with running water is run a foot or more down into the pile, which loosens the fish and causes them to move freely. By the use of these scows the fish are unloaded in a very short time, with but little labor, and are not marked by pew holes, as under the old method.

If the salmon have been in the scows for from 20 to 24 hours they are used as soon as possible after being delivered at the cannery; otherwise that length of time is usually allowed to elapse, the cannerymen claiming that if not allowed to shrink the fish will be in such condition that when packed much juice will be formed, and light-weight cans will be produced. The danger of canning fish that are too fresh, however, is of minor importance as compared with the tendency in the other direction.

Before dressing the fish a stream of water is kept playing over them in order to remove the dirt and slime, after which men with pews separate the different species into piles.

DRESSING

A number of the small canneries still use the old hand method of dressing the fish, and in such places the selection of the butchering or dressing gangs is of prime importance. Two men constitute a "butcher's gang," and the number of these gangs is dependent upon the output of the plant. Boys place the fish, with the head out, upon the cutting tables. One man cuts off the heads, and is followed by another who removes the fins, tails, and viscera. The offal is thrown into a chute, whence it passes to the reduction plant, from which it shortly emerges in the form of oil suitable for food or soap, dry fish meal for cattle and poultry food, and fertilizer, while the dressed fish is transferred to a tank of water, to be scaled, washed, and scraped. It is then passed to another tank of water, where it receives a second washing, scraping, and final brushing with a whisk-like broom, which removes any offal, blood, and scales that were overlooked in the first washing, after which it is removed to large bins on either side of the cutting machine.

The most useful cannery inventions in recent years have been of machines for doing the work of the dressing gangs. The one commonly known as the "Iron Chink," now in general use in canneries where such machines are employed, was first used in 1903 at Fairhaven (now Bellingham), Wash. It removes the head, tail, and fins and opens and thoroughly cleans the fish ready to cut into pieces for the cans. By the use of these machines the dressing gang is almost entirely done away with, dispensing with 15 to 20 men. This same machine is now so arranged that the fish after dressing are also "slimed;" i. e., the thick mucus covering the skin removed, and the inside of the fish cleaned.

CUTTING

The usual method of cutting the salmon is by a machine. This is generally a large wooden cylindrical carrier, elliptical in shape, thus having a larger carrying capacity. Ledges or rests on the outside the length of the carrier are wide enough to hold the fish, and are slit in cross section through the ledges and outer casing to receive the gang knives. The latter are circular, fixed on an axle at the proper distances apart, and revolve at the highest point reached by the carrier and independently of the latter. The carrier and gang knives are set in motion, each revolving on its own shaft. As a rest on the carrier comes to a horizontal position, men stationed at the fish bins lay a fish on each ledge as it passes. Thence it is conveyed to the revolving gang knives and, after being divided, passes through on the downward course, sliding off the rest into the filling chute. The knives in these machines are so arranged as to cut the fish transversely in sections the exact length of the cans to be filled.

The rotary cutter shunts the tail pieces to one side, and these are carried by means of a chute to baskets. The tail pieces are generally canned separately. As the tail portion is much smaller, with less meat, it can not be placed in the cans with the middle and head sections without detracting from their value, but if packed under a distinct and separate label, as is now done, there is no reason why the tails should not supply the demand for a cheap grade of fish.

In some of the smaller canneries, especially in those packing flat cans, the gang knives are worked by hand. In this case, the knives are not circular, but elongated or semicircular in shape, tapering at the outer ends. They are mounted on an axle having a large iron lever at one end, and when this lever is raised the ends of the gang knives are thrown up and back. The fish is then placed in position under them and the lever pulled forward, the knives, with a scimitar-like movement, dividing the fish.

The original method of cutting was by means of a long knife wielded by a Chinaman who stood at a regular butcher's block. Although his strokes were incredibly quick, the rotary cutting machine is a vast improvement over the old way.

SALTING

Every can of salmon is seasoned with one-fourth of an ounce of salt, which, to insure uniformity, is added by mechanical means. A table is used, in the top of which are holes equal distances apart. On the underside of the top is a sheet-iron plate, with an equal number of holes, which slides in a groove at the sides, and is worked either by a hand or foot lever. Just below is an open space large enough to accommodate a tray holding 36 or 48 cans. A workman stands in front of the table and slides a tray of cans into the open space. He then throws a quantity of salt upon the table and immediately scrapes this off with a thin piece of wood, each hole being filled in the operation, and the salt being prevented from falling through by the iron plate underneath. The lever is then pressed, the iron plate moves forward until the holes in it are directly under the holes in the table top, when the salt drops through into the cans. This operation can be repeated four or five times in a minute. Most canneries now use a small salter attached to the filling machine and this deposits the required amount in the can as it is passing by on its way to be filled.

FILLING THE CANS

Most canneries now use filling machines for all sizes of cans, although a few, more particularly those packing flat and odd-sized cans, still fill by hand.

The filling machine consists of a chute with a belt to which are attached wire racks about 4 inches apart, set at an angle to prevent the salt from spilling out, into which the salted cans are fed from the floor above and pass into the machine. At the same time the divided sections of salmon pass down another chute into the mouth of what looks like a hand coffee mill. They pass through here down a smaller chute and are forced by two dogs into a receptacle through which the plunger, or filler, passes. Here the plunger comes opposite the open mouth of the empty can, which when it reaches this point is caught by a clasp or hook and held in front of the plunger, which is immediately thrust forward through a chamber filled with salmon, cutting the fish longitudinally and at the same time filling the can. The next movement forces the can out upon a table. When running at full speed, one of these machines will fill about 80 cans a minute.

On being released by the clamp and rolling upon the table they are righted by a workman and pushed onto an endless belt, upon which they pass into the weighing machine. If of the proper weight, they pass through this machine, but if below the required weight the cans are shunted to one side, where workers add the quantity of fish needed, a supply of small bits being kept at hand for this purpose. Generally the cans overrun in weight, frequently as much as 2 or 3 ounces. Occasionally a can is weighed on a small balance scales in order to see that the machine is in perfect adjustment.

After passing the weighing machine any bones and scraps of flesh which may be sticking up out of the can are clipped away by workers armed with scissors.

In the hand method the fillers stand on each side of a long table with a trough running down the middle from end to end. This is filled with the cut pieces of salmon, and the fillers, usually women and children, put large pieces into the cans at first and then smaller pieces to occupy the vacant spaces.

From the weighing machine the cans pass to the clinching machine, which attaches the top of the can loosely to the body in such a way that it allows the air in the can to escape, yet prevents the fish from coming in direct contact with the steam of the exhaust box. Also the water resulting from the condensation of steam, which accumulates in the exhaust box, is kept from entering the can and thus bleaching the flesh.

In many plants the cans are washed by jets of water or steam directed against them in a closed box as they are passing from the clincher to the exhaust box.

The cans then pass into a steam exhauster, consisting in one type of a box about 30 feet in length, in which are three endless-chain belts running side by side. Under and over each belt are steam coils, and under each of the lower coils are single pipes, which through small holes throw jets of live steam upon the coils, creating an intense heat. The cans pass along the first belt, are then transferred to the second belt, on which they return to the entrance of the box, whence they pass to the third belt, and continuing along this to the end pass out to the double seamer, the whole operation occupying from 5 to 15 minutes, preferably 15. One style of exhauster has 10 ovals formed by the pipe, and the cans pass along these from side to side of the exhauster until discharged at the far end. Another type is formed of a long tube through which the cans pass and are heated by perforated steam pipes. Upright exhausters, in which the cans travel along a spiral, are also in use. By this means the contents of the can are heated and the greater part of the air exhausted, which is the object of the first cooking in the retort under the method formerly in general use. In Alaska, where 1-pound tall cans form the bulk of the pack, the cans are exhausted at a temperature from 206° to 212° F., 210° being the favorite.

A recent invention, which the inventor claims will do away with the steam exhaust box, and thus save a large amount of valuable floor space in the canning "line," is the power vacuum pump, known as vacuum exhausting machine, by means of which air is exhausted from the cans, accomplishing the same purpose as the steam exhaust box. Some of these machines have been in active use for several seasons, with most satisfactory results. Double seamers in which a vacuum is created in the can before the top is sealed on are now rapidly superseding other types, incidentally doing away with the steam exhauster, thus greatly reducing the amount of space required and doing away with the unpleasantly damp steam which leaked from the steam exhauster.

Leaving the exhauster, the cans pass to the double seamer, which fastens the cover on tightly with a double seam or crimp. It should be stated that no solder is used in attaching the top on the can, the curled flanges of the cover being coated around the outer edge with cement or other sealing fluid to take its place. Solder, however, is used in joining the side seam of the can, this being done when the can is manufactured. The cans then leave the machine on an endless conveyer, pass through a machine which washes the outside of the cans, and thence to the men who transfer them to the coolers, which are immediately placed upon the trucks and run into the retort for the one cooking they are to receive. By the use of these cans the soldering machine used in the old-style method is done away with. It also does away with the first cooking and the subsequent venting and soldering, a saving both in labor and time consumed.

COOKING

The processing time varies in each district and sometimes for each species. In Alaska 1-pound tall reds, cohos, chums, and pinks are generally cooked from 90 to 120 minutes, at 12 to 18 pounds pressure and at a temperature of 242° to 248° F. One-pound flats and half-pound cans are generally cooked about 10 minutes less time. Owing to their larger bones, king salmon are generally cooked from 10 to 20 minutes longer than the other species; steelhead trout also.

On Puget Sound 1-pound tall sockeyes, cohos, and pinks are generally cooked for 90 minutes at a pressure of 10 pounds and at a temperature of 240° F. Halves and 1-pound flats are generally cooked at the same temperature but for only 80 minutes. Chum talls are generally cooked for 105 minutes at a pressure of 10 pounds and at a temperature of 240°; while spring or king salmon are cooked for 120 minutes at a pressure of 10 pounds and at a temperature of 240°.

It is the custom at all canneries, no matter what the system, to allow about 5 minutes at the beginning of the cooking to work up the required heat of the retort, and when cooking is completed there is

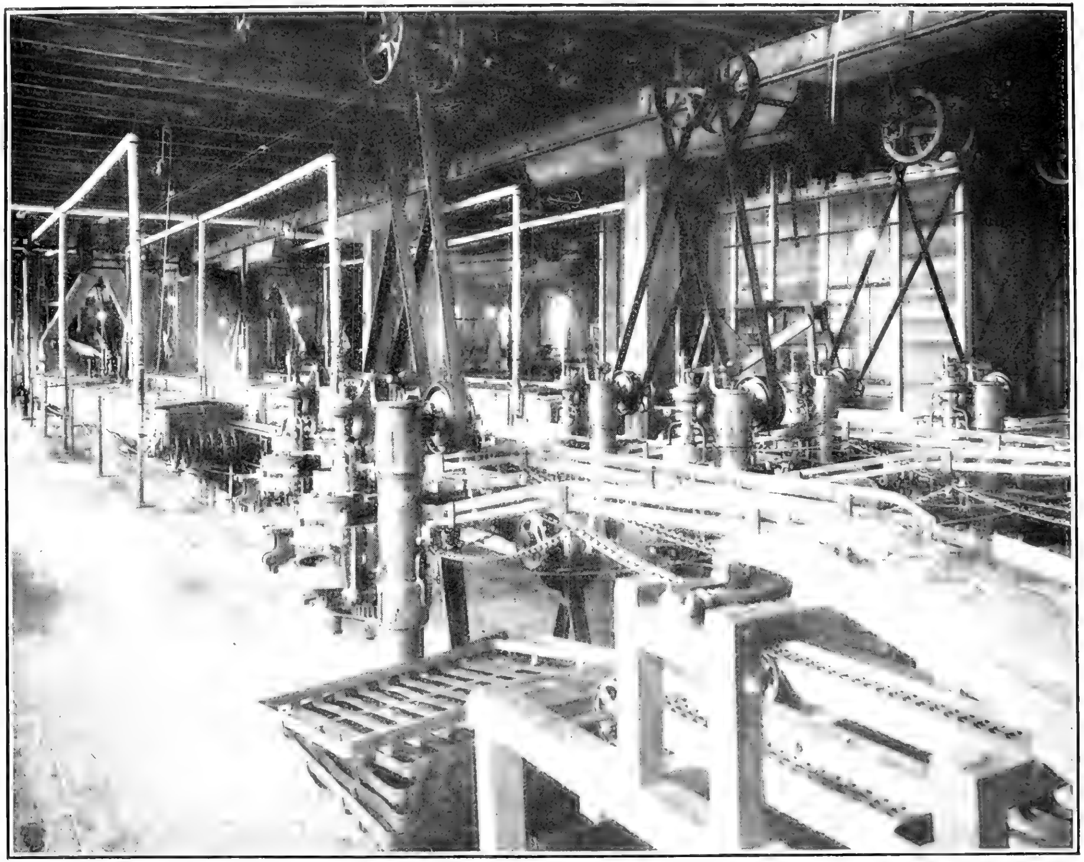

FIG. 30.--EXHAUST BOXES AND THE DOUBLE SEAMERS

FIG. 31.—COOKING THE SALMON IN RETORTS

a like period for reducing the temperature and pressure before opening the doors. The cooking times given above are exclusive of the two 5-minute periods noted here.

It should be distinctly understood that the processing times noted are only approximate. The condition of the fish, the weather—whether hot or cold, rainy or dry—etc., all must be taken into account. The canner can not go far astray, however, if he keeps generally within the narrow margins noted above. In the early days much secrecy and mystery was thrown about the cooking, and the work was carried on in a separate room, known as the "bathroom," under lock and key. The first cooking was done in common tubs. The early retorts were made of wood. Later, round iron kettles were substituted, nearly one-half consisting of cover, and round crates were used for holding the cans. At the present time only rectangular horizontal iron or steel retorts are used, and access to these is had by means of miniature railroad tracks.

For many years cannery men believed that the double cooking of salmon was absolutely necessary, but in 1898 F. A. Seufert, at his cannery on the Columbia River, at Seuferts, Oreg., a short distance above The Dalles, discarded this idea, and has since used a one-cooking method. By the new process the cans are tested for leaks after the center hole in the top is soldered up, as before, and are left in the retort 70 minutes at 245° F. and 12 pounds steam pressure. According to its originator, this method saves more than one-half the labor in the bathroom, saves nearly one-half the labor in washing the cans after cooking, and also better retains the color of the fish.

REPAIRING CANS

Imperfect cans which are discovered after cooking and are repaired at once and whose contents are recooked are still very good, the only difficulty being that by blowing or venting them a second time they lose weight. The above goods generally go in with the regular pack of their kind and are not classed as regular "do-overs." The latter were generally defective cans, which, owing to pressure of other work, could not be repaired until considerable time had elapsed, by which time decomposition had set in. The cans which can not be repaired immediately are now thrown onto the cannery dump.

On coming from the retort the coolers are lowered into a bath of lye, or, as in some canneries, the cans are run through such a bath on an endless belt, which, with the aid of a slight rinsing and a few rubs with a brush over the top, removes from the can all the grease and other material. The belt then passes them into another bath where the lye is washed off in hot fresh water. The cans then go to the cooling room, where a stream of water is played upon them, or during rainy weather are placed out of doors upon the wharf, and there allowed to cool, in order to stop the heat inside the can from continuing to cook the fish. In some canneries the lye bath before cooling is dispensed with, as the earlier washings are supposed to have cleaned the cans.

The top and bottom of the cans contract in cooling, and for several hours a sharp popping noise is heard. Here, as in nearly every process through which they pass, the cans are again tested, this time by tapping the tops with a small piece of iron about 6 inches long, or, sometimes, a 12-penny nail. The sound conveys to the ear of the tester an unmistakable meaning as to the condition of the can, and the faulty cans that escape notice during the other tests are almost invariably found in this one.

LACQUERING

A common custom in the salmon-canning industry, but one that is not common in the canning of vegetables, fruits, etc., is that of lacquering the cans. This idea of protecting the can on the outside has been followed from the very beginning for two reasons: (1) That the English market which, at that time especially, absorbed the greater part of these goods insisted on their shipments being finished in this way, and (2) from the fact, as these canners speedily found out, that if they did not protect their cans in some way enormous losses through rust would ensue.

The first experiment of this nature was to paint the cans by hand with red paint, treating each singly. Next a composition of logwood extract and alcohol was tried, which, however, did not produce satisfactory results for a very plain reason—the can was dyed instead of being lacquered. The next attempt was to varnish the cans with a japan varnish reduced with alcohol, but this was found to dry too slowly for speedy handling. After extended experimentation the quick-drying brown lacquer of the present time was evolved, which carries asphaltum in the form of an asphalt varnish as its base, this being supplanted in some cases by gilsonite. This lacquer can be procured in either a heavy or light body, is generally reduced with benzene or gasoline, and is applied according to the requirements of the market, which in some localities demands a heavy coating and in others a much lighter finish, the latter giving a rich golden brown color. Some experiments have also been made in using brighter colored lacquers for this work. Several of these, made to give a bright golden, copper, or other color, are extremely attractive in appearance, while at the same time protecting the tin against rust quite as well as the brown.

The industry soon outgrew the hand method of lacquering, and the process which for a number of years was universal in the trade and is still used by some canneries succeeded it. For this there are a number of rectangular box vats about 40 by 80 inches and 18 inches in depth, the number varying with the capacity of the cannery. These are usually lined with galvanized metal and provided with a gridiron-shaped iron frame, hung from a windlass or other tackle for lifting or lowering from top to bottom of the vat. The cans are loaded on this gridiron, being placed in an inclined position to allow the draining of the lacquer, and are lowered in the vat sufficiently to submerge them in the lacquer with which the vat is charged to a depth of 7 to 10 inches. The loaded gridiron is then raised to the top of the vat and the cans allowed to drain and dry before piling. This method, while being more effective in regard to the volume of work, was still of necessity a very slow and tedious operation. In damp or rainy weather, especially when it is not possible to open warehouse doors and windows, the gas arising from a number of these vats makes effective drying almost impossible.

Another principal objection to this method of lacquering, which applied also to all earlier attempts, was the impossibility of obtaining

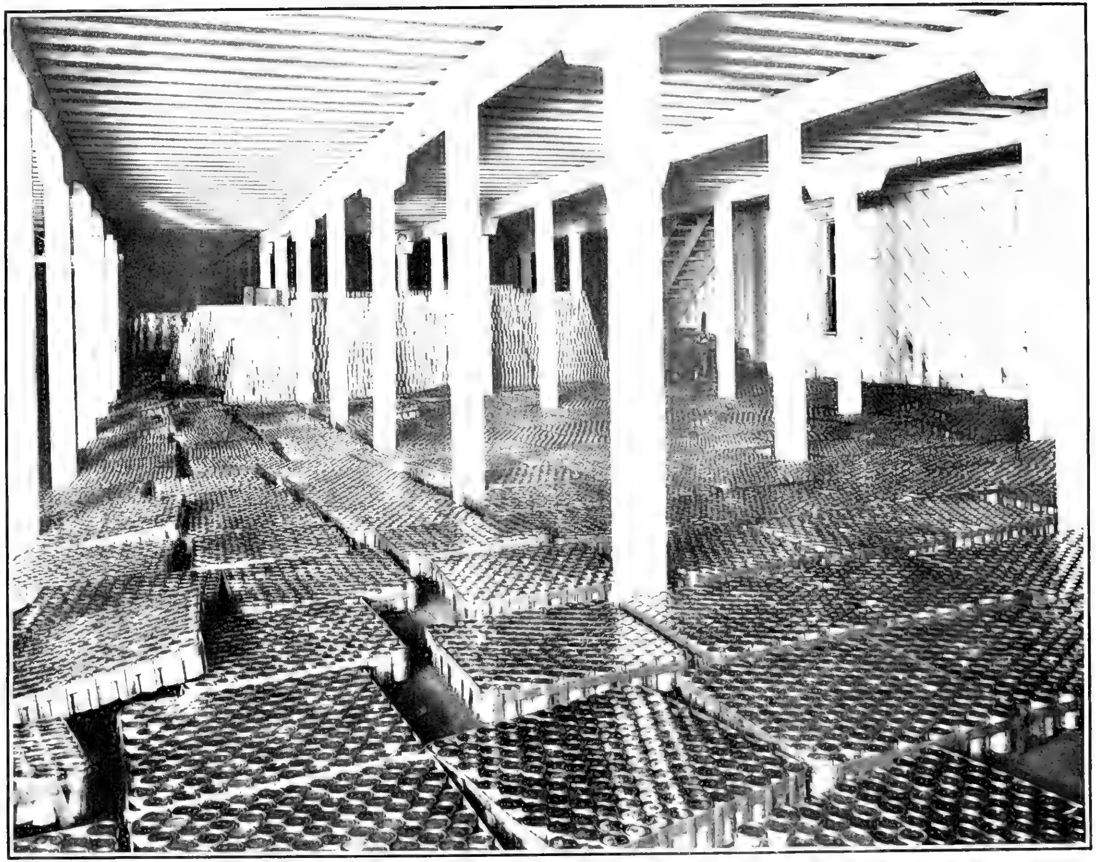

FIG. 32.—COOKED SALMON CANS COOLING

FIG. 33.—SALMON ON THE FLOOR OF THE FISH HOUSE

FIG. 34.—SALMON CAN-LABELING MACHINE

an even coat of lacquer when the can was allowed to dry in any stationary position. There was also a large waste by evaporation.

Notwithstanding repeated efforts at invention, however, it was not until 1901 that an effective machine for handling this difficult work was put on the market. The apparatus now in use by a number of canneries receives the cans on a revolving wheel fitted with rests for holding them while passing through the lacquer bath. From here they roll upon an endless chain which revolves the cans as they pass through a long box in which a hot blast dries them before they reach the end of the machine. The rotating or rolling motion given to the can after the lacquer bath, preventing the lacquer from draining to and consequently accumulating on any part of its surface, also has the effect of distributing the lacquer evenly and results in a clean and neatly finished can. The air blast facilitates the work of drying to such an extent that it requires only about two minutes after being deposited on the drying bed of the machine for the cans to be ready for handling, while the quantity of cans which can be handled in a day is vastly greater than by the old method.

A few flat and oval cans are not lacquered, but are protected from rust by wrapping in tissue paper, over which the label is placed.

Several of the largest operators have stopped lacquering the sides of the cans, depending upon the label to protect this portion from rust. Enameled ends are used, and, as these are bought from can makers, these operators are thus enabled to get away entirely from the dangers of lacquering.

LABELING

While machines have been made for this purpose, and some of them are in use, the work is usually done by hand. A number of men or women seat themselves about 4 feet apart in front of the pile of cans. Each man has in front of him a package of several hundred labels, and by bunching them on a slant so that successive margins protrude beyond each preceding, he can apply paste to the entire number with one stroke of the brush. A can is placed on the label, is quickly rolled, and the label is on much quicker than one can tell it. Each man places to his right the cans he labels, forming a pile of length and width equal to his unlabeled pile, and when the entire lot has been labeled it has been shifted only about 4 feet. Cans of fancy brands of salmon put up on the Columbia River and in the Puget Sound region are wrapped in colored tissue paper before the label is put on. Cartons similar to those used by the sardine packers would make good containers for fancy brands and would be much cheaper than the present method.

Some of the canners now have their labels lithographed directly on the tin, and the whole covered with a transparent lacquer.

Several attempts have been made to popularize salmon packed in glass and porcelain jars, and while these have met with some favor, it was not sufficient to warrant a continuance of the practice for any length of time. But few are being so packed at the present time.

BRANDS

A very important feature of the canning industry is the selection of appropriate brands or labels for the various grades of salmon. Each company has a number of these, which it has acquired either by designing them or by absorbing another company which owned them. A well-known brand has a value in itself and sometimes is a very important asset. A company will sometimes market a considerable part of its product in one section, and here, where the consumer has become familiar with the brand and pleased with the contents of the can, he will ask for and accept no other, despite the fact that the latter might be, and probably is, the equal of the product he has been using.

For many years but few salmon canners appreciated the value of a can label, and it has taken some bitter experiences to drive home to the rest that a properly designed label placed upon good goods and the owner protected in its use by the law has real value, just as much as boats, nets, buildings, machinery, or the thousand and one material things required to carry on the business.

A free trade definition of a label would be that it is an artistic representation or intellectual production, stamped directly upon an article of manufacture, or upon a slip or piece of paper or other material, to be attached in any manner to manufactured articles, to bottles, boxes, and packages containing them, to indicate the contents of the package, the name of the manufacturer, or the place of manufacture, the quality and quantity of the goods, directions for use, etc.

Labels are subject to the copyright law and should be registered before use or publication. If not registered, there is no protection in law against infringement. The continued use of a label, however, will give the person so using a certain proprietary right in it, which can be enforced in a court of equity and may be defended by injunctions, which will generally be granted. Such proceedings are expensive, annoying to a busy man, and at best will protect one only after at least a certain amount of damage has been done, and it is far safer to avoid this by registering the label at the time of issue, which will give one the further advantage in that a description of the character and quality of the article labeled can be set forth, which will, to a certain extent at least, be protected with the label.

The commercial value of a label and name is represented by the more or less general demand for the goods protected by it. In the canned-salmon industry, as in that of other food-packing industries, certain labels, through the good quality of the goods marketed under them and the publicity created for them, have become of very considerable value to the owners. A case in point is the label Royal Crown, owned by the late R. D. Hume. This was one of the earliest brands marketed in England, and some years later a certain Liverpool firm of salmon handlers paid Mr. Hume the sum of $10,000 for the exclusive right to its use in England.

In designing a label there are several things which should be borne in mind. It should bear an easily remembered name and design; a name difficult of pronunciation should be avoided at all costs. For many years glaring red labels have been popular, but the success met with by those using more subdued and artistic designs and coloring indicates that the public appreciate them more than they do the older and coarser types. The design should be as simple as possible, as experience has demonstrated that a simple form—so simple that it can be fully understood by a mere glance—will gain by regular repetition, while a more complicated design will lose in this process.

A good many now in the business still remember the small label that was used on salmon cans before 1870. Labels about 3 by 5 inches in size, printed in one color, on white or colored newspaper, served merely the purpose of distinguishing cans, telling contents and manufacturer, and were without commercial value. About the year 1870 a few canners commenced to import from the East and Europe full-sized labels, i. e., labels that went all around the can. These were called by some "Pennington" labels, as a firm of that name supplied quite a number of them.

For some years they were used for the best grades only. They were printed in four and five colors, the design showing invariably a number of panels of different shapes and sizes. The lettering was not always plain and sometimes even intentionally irregular and puzzling. The colors were placed side by side, in boldest contrast, without any attempt to harmonize them.

It was soon discovered that the highly colored panels, while striking, lost all effect when massed on the retailer's shelves, and the different brands looked so much alike that the individual designs could not well be remembered by the customer, the only really distinctive feature being the name, and that was generally printed so small and indistinct that it could not be readily seen at a distance.

To remedy these defects, the designers soon reduced the number of panels and subdivisions, increasing meanwhile the size of the remaining ones and filling them with distinctive designs, still colored as simply as before, with no attempt at blending of colors. The background, at first perfectly plain, commenced to show patterns more or less complicated, and at times quite pretentious, so as to take away from the design proper.

Gradually the panel design disappeared. In place of it some showed one continuous picture on the label, which was very unsatisfactory and soon disappeared, as only a fraction of the picture could be seen at one time. Others had two subdivisions, one showing the name of the brand with its illustrations, occasionally used as a trade-mark, the other showing the article packed in the can, both named and illustrated. Unfortunately, these subdivisions were so large that the roundness of the can prevented one from seeing the picture as a whole, but this was soon remedied by making the subdivisions narrower and filling in between with directions, weight of contents, etc.

From this point on the general plan of labels underwent few changes except that the work, both of the artist and pressman, improved wonderfully, some of the labels now designed and printed being real works of art.

Up to a few years ago one of the most serious evils in the trade was the use of misleading and lying brands. The high-grade product would almost invariably be correctly and fully branded, but "chums" and "pinks" were usually branded as "Fresh salmon," "Choice salmon," etc., which would deceive all persons but those well acquainted with the industry. "Do-overs," and very poor fish, were usually marketed under a brand which bore the name of a fictitious company or of no company at all.

The passage of State laws of varying degrees of efficiency governing the branding of salmon helped slightly to remedy this condition of affairs, but it was not until the pure food and drugs act, approved June 30, 1906, was put into force by the Government that any radical improvement was noticeable. At the present time but few misleading brands are in use.

BOXING OR CASING

A case of salmon generally contains 48 one-pound cans or their equivalent, i. e., 24 two-pound cans or 96 half-pound cans. Some canneries pack their half-pound cans in cases of 48. These cases are usually made of wood and cost from 9 to 11 cents each knocked down.

CAN MAKING

Some of the canneries in the coast States and Alaska purchase their cans ready-made, but the usual method is to purchase the sheet tin and make up the cans in the canneries. This is especially necessary in Alaska, as it would be impossible to find room on the cannery ships for such a bulk as they would make in addition to the other supplies necessary. Furthermore, the making of cans provides work for a large part of the crew, otherwise unemployed while the rest are getting ready the other necessary paraphernalia. The work is done by machinery and occupies several weeks' time.

Of recent years the objection to the great amount of space occupied by the cans when shipped by freight has been overcome by making the body of the can, pressing it flat, and shipping it in this compact shape along with the ends. At the cannery is a machine for rimming the flattened body into a round shape once more, when the end can be put on with the regular double seamer.

CANNING SMOKED SALMON

A number of ventures in the line of canning smoked salmon have been made on this coast, but most of the pioneers were not content or able to invest the amount of capital needed and wait the time required to create a demand for such products, and soon quit.

One of the leading British Columbia packers, H. Bell-Irving & Co., some years ago put up in cans some pink salmon which had been treated to an artificial smoke in a vat, and these are said to have made a favorable impression in Australia. Another canner operating on the Fraser River smoked pink salmon, and then, cutting them to the proper length, packed them dry in half-pound cans.

In 1908 the Columbia Canning Co. put up at its cannery on Chilkoot Inlet, Alaska, some smoked salmon which had been shaved into thin strips like dried beef. These, called "Flaxamo," were packed in oil and were very good, especially in making sandwiches.

In 1915 two companies began in Seattle the smoking, slicing, and canning of coho and king salmon. These were put up in oblong flat cans of various sizes, similar to sardine cans, 2¼, 4½, and 7½ ounces, respectively, while for a special trade a 7½-pound can was also packed. These fish were cut quite thin, about 40 to 50 slices to the pound, and were packed in hermetically sealed cans with cottonseed oil. The fish were all hard smoked before slicing and canning. The business was abandoned the next year but was resumed by another company in 1928.

The same companies are also putting up kippered salmon in cans.

Salmon loaf, made by mixing salmon with flour and various other ingredients, thus producing a paste, is also being canned by several packers.

A straight salmon paste, made solely from the flesh of the salmon, and mixed with oil and spices, is being manufactured by one of the leading packers.

FIG. 35.—MAKING SALMON CANS

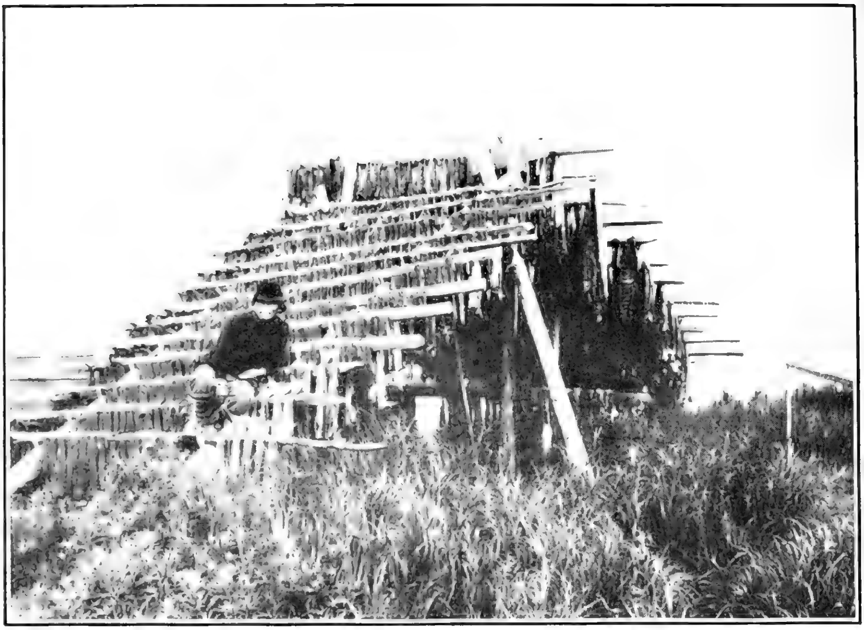

FIG. 36.—AN INDIAN SALMON DRYING RACK, BERING SEA, ALASKA

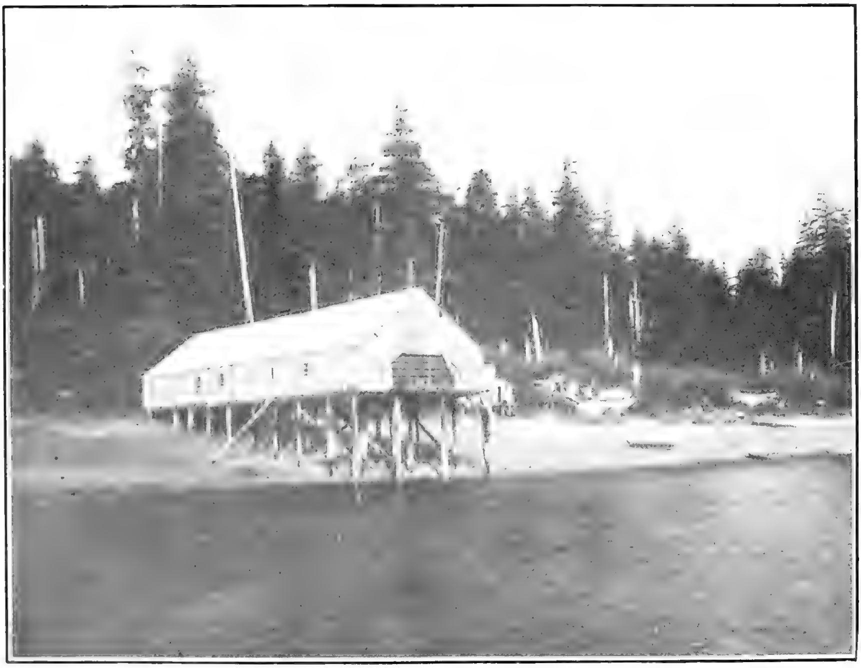

FIG. 37.—THE BARONOVICH SALMON SALTERY; THE OLDEST SALTERY IN ALASKA

HOME CANNING

At a number of places along the coast it has become the custom for the thrifty housewives to do a little home canning of salmon for winter use when the fish are abundant and cheap, and they find canning salmon as easy as canning vegetables and fruit. The fish are dressed, skinned, and the backbone removed. It is then cut into transverse strips of a size to fit either a pint or a quart glass jar, whichever is to be used. The jars are then filled with the pieces, salted to taste, the rubber ring put on, after which the can cover is put on loosely so that the steam may escape. Strips of thin wood are placed at the bottom of a kettle or wash boiler and the cans set down on them. Enough cold water is then poured into the kettle to bring it up to within about 2 inches of the top of the cans. The kettle is then put on the stove and, after it comes to a boil, note is made of the time, and the cans are cooked from one and one-half to three hours. There seems to be a great variation in the time of cooking on the part of the operators. Some even cook only one hour, but these generally use a preservaline. About three hours seems to be the best time, as the bones are then quite soft. At the end of the cooking period the tops are tightened, the kettle removed from the stove, and the water and cans allowed to cool in the kettle.

Portable retorts and hand double seamers are now available for household use, and as a result many are using tin cans as containers. A recent improvement on the double seamer permits of the use of a tin container three times, thus materially reducing the heavy expense for cans.

INSPECTION OF PLANTS PACKING CANNED SALMON

For some years there has been a desire on the part of a majority of the salmon canners for some form of inspection of the plants and of the pack made. The widespread suspicion that the salmon pack of 1918 was considerably below standard, which suspicion resulted in heavy monetary loss to the packers, gave a great impetus to this desire. The National Canners Association, an organization composed of the majority of the canners of the United States, a few years before, at the request of the sardine canners of Maine, organized them into the sardine section of the association, and by an assessment of a small sum per case raised sufficient funds to provide an inspection service to see that the plants were put into and kept in a satisfactory sanitary condition and also to inspect the goods packed and, if they were up to the standards fixed in advance, to affix to the cans suitable certificates attesting this.

At its annual convention in 1919 the association decided to extend a similar service to any other section willing to assess itself to pay the necessary expense. In explanation of its plan the association issued the following circular shortly after the convention had adjourned:

1. This service is installed by the National Canners Association, with which a direct contract is made by each canner.

2. It runs for a term of three years and is applied in States or local territories where similar conditions are to be met.

3. The cost of the inspection is paid by the canners in the territory named through an assessment which, in the past, has been collected by the can companies with which each canner deals. This cost is added to the can invoice, and is remitted by the can companies to the treasurer of the National Canners Association each month.

4. In order to meet the preliminary expenses of the inspection before the regular fund becomes available, each canner who signs a contract will pay into the treasury of the National Canners Association, within 30 days after signing the contract, an assessment of one-half cent per case on his pack of 1918, on the commodities to be inspected. Should the total sum raised during the season be greater than the expenses of inspection during the season, a refund of all or a portion of the one-half cent per case will be made after a small sum is reserved to maintain a consistent surplus.

5. The treasurer of the National Canners Association distributes this money to the local sections where the money is to be spent.

6. The National Canners Association has no profit in this inspection—its only requirement being that each canner under inspection is a member of the association, and pays the membership and general dues.

7. A director or supervisor of inspection is appointed by the National Canners Association who in turn appoints his assistants. The salaries of the director or supervisor and his assistants are fixed by the National Canners Association which works in harmony with the judgment of the advisory board. The director or supervisor must be a man of superior ability, preferably one with scientific training. He must also be a good executive.

8. The director or supervisor acts in conjunction with the advisory board which may consist of five, seven, or nine members. This advisory board is elected by the canners in the States or Territories covered. The duties of this board are what its name implies, "advisors." In point of actual experience, it is found this advisory board is able to settle all practical disputes and misunderstandings which may arise under this method of inspection. There is always a final appeal to the executive committee of the National Canners Association.

9. The National Canners Association does not promise or guarantee to issue certificates of inspection, but in territories where inspection has existed, the certificates have been issued on products which merit the same. It should be distinctly understood, however, that this does not form any part of the contract.

10. The cost in territories where inspection has been applied has been 1¼ to 2 cents per case. It is impossible to advise in advance definitely what the cost will be, as the local conditions differ. It should be borne in mind that there must always be a sufficient number of inspectors to protect the inspection, and if canners are widely scattered, this, as a matter of course, will increase the number numerically—not in proportion to the pack.

11. The inspection covers sanitation in plants, quarters for employees, and sanitation of the product. It is also proposed, as the work progresses, to apply inspection to the character of the raw product, and grading of the same. This grading on staples will be worked out on recommendation from the advisory board, which will be harmonized so as to give a uniform grade to each product through the entire country.

12. In localities where inspection has been installed, local laboratories purchased and financed by the funds for inspection, have been found most useful. These laboratories furnish prompt facilities for canners for testing their product and working out manufacturing problems which come up during the activities of the canning season. These laboratories are established and work in harmony with the research laboratories of the National Canners Association, Washington, D. C.

13. This inspection can well be made the basis of a consistent publicity advertising campaign, should the industry adopt it generally, in time to guarantee its working satisfactorily during the canning season of 1919. The present plan, however, does not include this publicity campaign, as this is a matter which must necessarily be passed upon later by the canners themselves.

14. Copy of contract with each canner is herewith inclosed, for information.

On February 17, 1919, the matter of adopting this inspection system was submitted to the salmon canners of the Pacific coast and accepted by a large majority. A chief inspector and a number of assistants were appointed, who carried on a sanitary inspection of the various canneries for several seasons. As the results obtained did not seem to justify the outlay required it was finally abandoned. It had been hoped to expand the work to include the quality of the pack itself, but it was soon seen, however, that only a stamp of approval of quality from the Government itself would carry sufficient weight to make it worth while.

One excellent result of the agreement with the National Canners Association was the installation of a northwest branch laboratory at Seattle in 1919, where a staff of scientists have since been at work on the many problems which beset the salmon canner. A number of these have been carried to a successful conclusion and the results published; and due to this the quality of the annual pack has been wonderfully enhanced with a corresponding financial return to the individual packer.

INVESTIGATION OF CANNED SALMON INDUSTRY

In 1917 and 1918 an investigation of the canned salmon industry was made by the Federal Trade Commission and many valuable statistical data were gathered and published.[33]

The following table shows, with other data, the average number of fish per case of each grade packed in the different geographical sections.

Number of fish canned and purchased, number of cases packed, and average number of fish per case [1]

1916

District	Grade of fish	Number of companies reporting	Number of fish canned	Number of fish purchased	Percentage of fish canned which were purchased	Number of cases packed	Average number of fish per case
West Alaska	Kings	7	111,381	27,175	24.39	26,003	4.28
Central Alaska	do	6	25,483	11,602	45.52	5,854	4.35
Southeast Alaska	do	20	148,286	136,597	92.12	34,344	4.31
Puget Sound	do	15	180,580	80,574	44.62	25,606	7.05
Columbia River	do	9	865,392	842,127	97.31	265,376	3.26
Outside rivers [2]	do	7	60,656	60,143	99.15	18,607	3.25
Totals and averages		64	1,391,778	1,158,218	83.66	375,790	3.73
West Alaska	Reds	8	16,564,413	1,017,042	6.13	1,223,950	13.52
Central Alaska	do	6	1,387,647	547,261	39.43	118,891	11.67
Southeast Alaska	do	29	1,609,978	784,503	48.70	123,767	13.00
Puget Sound	do	17	2,593,240	168,584	6.50	198,205	13.04
Columbia River	do	8	775,382	439,900	56.73	67,334	11.52
Outside rivers [2]	do	1	59,352	59,352	100.00	4,645	12.78
Totals and averages		69	22,990,012	3,016,642	13.28	1,736,792	13.24
West Alaska	Medium reds	4	394,048	46,619	11.83	36,078	10.92
Central Alaska	do	6	305,246	131,998	43.22	37,275	8.19
Southeast Alaska	do	29	1,018,014	505,937	49.67	117,422	8.69
Puget Sound	do	17	1,099,374	677,485	61.62	110,658	9.93
Columbia River	do	10	346,597	310,216	89.50	42,782	8.10
Outside rivers [2]	do	8	349,053	349,348	100.09	34,937	9.99
Totals and averages		74	3,512,332	2,331,819	66.38	379,152	9.26
West Alaska	Pinks	3	4,153,353	540,248	13.00	214,482	19.36
Central Alaska	do	6	4,102,775	1,821,558	44.39	212,169	19.33
Southeast Alaska	do	27	12,266,379	4,772,128	38.89	879,953	13.93
Puget Sound	do	8	1,800,875	607		70,979	25.37
Totals and averages		44	22,323,382	7,134,541	31.99	1,377,583	16.19
West Alaska	Chums	7	1,144,595	289,663	25.30	97,528	11.74
Central Alaska	do	6	331,423	160,465	48.41	37,870	8.75
Southeast Alaska	do	28	3,661,176	2,296,478	62.72	344,213	10.63
Puget Sound	do	15	2,981,678	1,887,278	63.29	387,373	7.70
Columbia River	do	8	374,370	358,255	95.69	62,043	6.34
Outside rivers [2]	do	5	110,809	106,973	96.53	16,896	6.56
Totals and averages		69	8,604.051	5,099,112	59.26	945,923	9.10
Columbia River	Steelheads	7	103,774	102,117	98.40	16,991	6.10
Totals and averages		7	103,774	102,117	98.40	16,991	6.10

[1] Report of the Federal Trade Commission: Op. cit., pp. 15, 16.
[2] Coastal streams in Washington, Oregon, and California.

[33] Report of the Federal Trade Commission on Canned Foods. Canned salmon. December, 1918. 83 pp. Washington, 1919.

Number of fish canned and purchased, number of cases packed, and average number of fish per case—Continued

1917

District	Grade of fish	Number of companies reporting	Number of fish canned	Number of fish purchased	Percentage of fish canned which were purchased	Number of cases packed	Average number of fish per case
West Alaska	Kings	8	107,590	18,407	17.10	21,398	5.03
Central Alaska	do	9	34,158	19,872	58.19	6,675	5.11
Southeast Alaska	do	22	283,643	202,693	71.46	45,674	6.21
Puget Sound	do	18	209,360	105,731	50.54	53,485	3.91
Columbia River	do	10	959,846	643,063	6.99	273,291	3.51
Outside rivers [2]	do	9	45,378	43,468	95.75	12,940	2.30
Totals and averages		76	1,639,975	1,033,234	63.00	413,463	3.96
West Alaska	Reds	9	21,449,913	1,192,000	5.56	1,433,780	14.90
Central Alaska	do	9	2,271,989	974,653	42.89	189,921	11.96
Southeast Alaska	do	33	1,964,993	1,074,658	54.95	158,582	12.03
Puget Sound	do	27	4,731,861	1,233,489	26.00	372.467	12.73
Columbia River	do	7	1,213,887	688,637	56.72	98,076	12.36
Outside rivers [2]	do	2	21,868	21,868	100.00	1,769	12.36
Totals and averages		87	31,654,511	5,185,305	16.40	2,254,595	14.13
West Alaska	Medium reds	3	145,837	18,385	12.60	13,406	10.87
Central Alaska	do	9	238,572	141,424	59.29	30,430	7.84
Southeast Alaska	do	33	1,033,339	419,046	40.55	98,324	10.51
Puget Sound	do	27	813,269	501,857	73.90	91,991	8.84
Columbia River	do	10	728,221	587,879	80.72	47,861	15.11
Outside rivers [2]	do	10	394,779	376,224	95.29	34,417	11.48
Totals and averages		92	3,349,017	2,044,815	61.05	316,429	10.58
West Alaska	Pinks	2	3,958,391	1,175,748	29.70	219,508	18.03
Central Alaska	do	10	5,221,887	2,172,476	41.62	324,230	16.11
Southeast Alaska	do	33	24,166,834	10,473,748	43.30	1,362,187	17.26
Puget Sound	do	26	11,805,693	6,361,891	53.80	858,396	13.68
Columbia River	do	1	77,081	14,635	18.98	4,761	16.21
Outside rivers [2]	do	1	62,892	62,892	100.00	4,222	14.89
Totals and averages		73	45,292,778	20,261,390	44.90	2,773,304	16.29
West Alaska	Chums	9	527,982	194,962	36.92	54,215	9.74
Central Alaska	do	33	728,514	418,419	57.43	79,208	9.20
Southeast Alaska	do	26	4,087,578	2,554,968	62.49	480,895	8.50
Puget Sound	do	27	2,547,457	1,852,350	72.71	249,390	10.22
Columbia River	do	8	277,836	123,436	44.42	28,085	9.89
Outside rivers [2]	do	7	88,736	84,413	95.12	11,655	7.61
Totals and averages		119	8,258,103	5,228,548	63.31	903,448	9.14
Puget Sound	Steelheads	1	33	33	100.00	5	6.60
Columbia River	do	10	138,421	145,581	105.01	22,234	6.71
Outside rivers [2]	do	1	787	787	100.00	126	6.24
Totals and averages		12	139,241	146,401	105.00	22,365	6.22

[2] Coastal streams in Washington, Oregon, and California.

MILD CURING

The beginning of the business of mild-curing salmon, or "sweet pickling," as it is sometimes called, is of comparatively recent date. In 1889 a German dealer came to the Columbia River and tried to interest some of the cannery men in the business. J. O. Hanthorn, M. J. Kinney, and J. W. Cook were persuaded to prepare some, and the plant of the Northwest Cold Storage Co., at Portland, was used to keep the fish at a low temperature during repacking and preparation for shipment. These fish were shipped to Germany, but the shippers received no financial returns, word coming back that the fish were not satisfactory.

Owing to this lack of success from the first effort, no further attempt was made until 1894, when Mueller & Loring, of Chicago, put up a carload of mild-cured salmon at Kalama, Wash., and shipped it to Germany. In 1896 Charles Ruckles and Wallace Bros., of Kalama, packed several carloads for the German market. It was not until 1898 that the business was permanently established on the Columbia, the Trescott Packing Co. and S. Schmidt & Sons putting up plants at Warrenton and Astoria, respectively.

In 1900 the Trescott Packing Co. began packing the spring and fall runs, and the Sacramento River Packers' Association packed the fall run, on the Sacramento River, the business being carried on here every year since.

In 1901 the Sacramento River Packers' Association began at Monterey the mild curing of the spring salmon that were taken with hook and line in the open ocean.

S. Elmore & Co. started the industry in 1902 at Tillamook, and the business began on Puget Sound in 1901, when the San Juan Fishing & Packing Co. and the Seattle Fish Co. took it up. The Pacific Cold Storage Co. began the next year at Anacortes.

Prior to 1906 several of the Alaska cannery men put up each season a few tierces of mild-cured salmon, but it was not until this time that the industry really began as such. In that year J. Lindenberger (Inc.) started packing at Ketchikan, Alaska. The following year several other plants were started, and in 1910 almost all of the king salmon taken in southeast Alaska were mild cured. The same is true to-day.

For mild curing the fresh fish must be given greater care in handling than is the case with any other process. Care must be exercised to see that the flesh of the fish is not bruised or broken, and in order to make sure of this the handlers usually pack several fish in one box, with cracked ice over and around them if the weather is warm. As soon as a box is filled, it is put in the hold, where the boxes are stacked one upon another, but prevent more weight than is represented inside one box coming upon any one fish.

In dressing, the head is removed, care being taken to leave as much of the bony structure of the head as possible to assist in holding the side of the hooks when it is being smoked later on; the fish is then split down the belly to the vent, the entrails removed, when a cut is made on either side of the blood clot in the back, and the fish passed to the "washer," who holds the fish on its back in a slot on the table under a spray of water, and removes the membrane of skin which covers the inside of the backbone and inside of which a good deal of thick blood lies, by means of a large spoon or some similar form of scraper. A knife should not be employed. Some curers do not remove the fins at this stage, while others do.

The body is then scored along the sides with a small knife, care being used to cut the skin only; this allows the salt to penetrate more freely and thus assist the process of cure. A specially prepared eccentric wheel is sometimes used for this purpose, which makes a series of small cuts varying from half an inch at the tail to 1½ inches long at the shoulder, and from 2 to 3 inches apart.

The fish is now ready for the splitter, who turns it on its back with the open belly toward him and forces the shoulder down on a sharp-pointed nail, so the fish will not slip during the operation. A cross-cut is first made across the root of the tail to the bone, but no deeper.

Then the knife is entered at the vent, immediately above the bone, and a cut, which should go no farther back than the middle of the backbone, is drawn down to the crosscut already made. Then raising the lug with his left hand, the splitter enters the knife at the shoulder above the bone, and with one sweep from head to tail, separates the entire side. This is the more easily done if the fins have been previously removed. If the work is perfect, there will be no flesh left on the bone, but a line of fat will show down the center of the side. This improves the appearance of the fish and adds to its value.

In order to remove the bone from the remaining half of the fish, the splitter inserts the knife under the bone, about the vent, and draws down toward the tail, but care must be taken, as before, not to go farther back than the spine. The splitter now takes the fish off the nail, holding it by the lug, his left thumb resting on the upper, or inside of the fish, and his fingers on the lower, or skin side. The tail is now pointing away from the splitter, who enters his knife carefully under the backbone, and with one dexterous outward sweep separates the bone from the fish right down to the root of the tail. When abreast of the crosscut, however, he turns the knife sharply downward, and cuts off the fish the same as on the other side. As with the first half, no flesh should be left adhering to the bone, and the line of fat should show down the center. In other words, the two sides should be exactly alike.

The sides are dipped into cold water in the dress tank, and are then laid, skin side down, on the table with the thin or belly edge toward the front. A man then removes any blood remaining in the veins on the inside of the fish, by pressing it away from him toward the back of the fish, either with his fingers or with a spoon. If the blood is not squeezed out in this way the salt will harden it during the process of curing, and the flesh will become dark in color. The sides are then dipped in a tank of weak brine and crushed ice to give them a final wash, but should on no account be left to soak in the brine. Upon removal, they are again scraped to insure the removal of all the blood from the veins.

Great care must be used in handling the newly split sides, as they are very tender and may be easily broken or bruised. In lifting them by the lug or collar bone, the curer should have his fingers to the inside and his thumb to the outer or skin side; otherwise the skin may be broken.

The sides are then taken to the salter, who lays them, skin side down, on a salting table, on which has been dumped a quantity of dairy salt, and gently rubs the flesh with the salt, lifts it up with only such salt as will adhere to it, and places it in the tierce.

The tierces in which the salmon sides are packed are stout casks made of fir or spruce, bound with six strong galvanized hoops. They contain about 800 pounds of fish, but when full of pickle the gross weight of cask and content is between 1,100 and 1,200 pounds. A plug hole is bored in the head of the tierce.

Two or three handfuls of salt are thrown over the bottom of the tierce, then a layer of salmon sides, skin down, and two or three handfuls of salt are sprinkled over them. In packing two sides of fish, crossed head and tail are packed close to opposite sides of the tierce, the back or thick part of each side being placed close up against the side of the tierce. Other sides of fish are packed from the sides toward the center of the tierce, napes and tails alternately, the back of each side being drawn halfway up and resting on the side already laid. When complete, the layer should be perfectly level, and this depends a good deal on how the last or center piece is laid. Salt is sprinkled between each layer in the manner and quantity noted above and the process continued until the tierce is full. The tiers should be crossed in packing. The top layer should be placed with the skin up and have extra salt put on. From 85 to 100 pounds of salt are used to 800 pounds of fish.

The tierce is then headed up, after which pickle is poured in until the tierce is quite full. This pickle may be made with the same salt as is used for rousing and sprinkling the fish. Perfectly clear water should be provided and broken ice should be added in liberal quantities, if the weather is warm. Before using, the pickle should be strained through a fine sieve or a clean cloth, to remove froth and sediment. A centigrade saltmeter is used by most mild curers. The pickle is made to a strength of at least 90°, but it usually weakens to about 70° during the first 10 days of cure, whereas after repacking it should not readily come below 85°, and it should retain that strength for a long time.

When tierces have been filled with pickle they are rolled inside a cold-storage room, with a temperature of 35 to 38° F., where they may be tiered two tiers high. Very little variation in the temperature is allowable, as it would start the oil or fat in the flesh, allowing it to escape into the brine.

Unless the tierces are kept quite full of pickle the sides of fish are apt to be broken when the cask is rolled about. The tierces must be examined frequently to see that they are full of brine, as there are always small leaks, while the staves absorb more or less moisture. Furthermore, if the tierces were allowed to leak, ugly yellow spots would show on the parts of the fish that were left dry. Thus it is of the utmost importance, both during the two or three weeks allowed for pining and also after repacking, to see that they are kept full of pickle. Several gallons of pickle may be absorbed by each cask during the first two or three weeks of cure.

The actual shrinkage during the two or three weeks in which the fish lie in the first packing may be reckoned at 30 per cent. Fat, well-conditioned fish, especially those which are caught in the ocean, shrink less, but poor fish, especially those caught when well on their way to the spawning grounds, shrink more—sometimes up to 35 per cent.

After holding the fish in storage for at least 20 and not more than 90 days they are taken out of the tierces. Each side of fish should be lifted out carefully, as described above, and sponged with a large sponge until all salt and slime are entirely removed, leaving only a clean, red side of fish. Either pure ice water or ice pickle may be used for this washing, but it will depend entirely on the quality and condition of the fish. Soft, poor fish would require pickle, but good firm fish may be washed in clean ice water.

The sides are then weighed and graded accordingly, 6 to 8 pounds, 8 to 10 pounds, and so on, being the grades. Sides of 11 pounds and over are called *large* fish, and "L" is marked on the side of the tierce. Some curers grade their sides from 9 to 11 pounds and class them as *medium* and mark them "M;" smaller sides are termed *small* and are marked "S."

After the sides have been graded they should be counted and repacked, the defective sides, such as thin-bellied, torn or broken, being put by themselves. Fish which are considered perfect are called No. 1; those which do not come up to that standard are termed No. 2, and are marked accordingly; while fish that have any taint of sourness are marked "T." In repacking, the sides of fish should be replaced as nearly as possible in their original position, those curved in shape being placed against the sides of the cask and straight pieces laid in the center of the tier. No salt is used in repacking, but as soon as the tierce is filled, the head put in, and the air test applied it is laid on its bilge and filled up with ice-cold pickle made to a strength of 90° salometer (90 per cent saturation) that can be made from fresh or salt water, whichever is handiest and cleanest, half-ground salt being used. There will be about 830 pounds of fish on an average in the tierce after repacking, and some 14 gallons of pickle may be required to fill the cask up. They are then put back into cold storage and pickled at the bilge daily for at least a week. If kept for any length of time, they would, of course, have to be tested, regularly—a tap with a hammer would do—and any leakage promptly rectified. If properly cured, the fish should keep in good condition for months in cold storage, provided the casks are sound and kept full of pickle.

On the head of each tierce are put the following marks: Initials of packer or packers; initials of place where packed; number of tierce (consecutive); number of sides in tierce, the tare, and the gross weight (weight of pickle not counted); quality of fish (I, II, or T); and size of fish (L, M, or S).

If of first quality, no mark is necessary, but second-quality and tainted fish have to be noted.

In the early days of the industry different preparations, which included salicylic and boracic acids, were used to help preserve the fish. This caused much complaint from the Germans, and finally their Government subjected our product to a rigid inspection, with most salutary results, as now it is one of the purest and best products put up on this coast, the use of acids being done away with entirely.

The king salmon is almost invariably the species mild cured, being the only one large enough to answer the requirements of the trade. In 1907 a Ketchikan (Alaska) packer put up a quantity of coho, chum, and humpback salmon, but he found so much difficulty in disposing of the product that he abandoned further efforts in this line. A few cohos are put up each year.

The principal consumers of the mild-cured salmon are the smokers, who take them from the tierce, wash and soak them for a few minutes, and then have a practically fresh fish to smoke, and not, as in the days when hard-pickled salmon were used, one that had lost most of its oil and flavor through the excessive amount of salt needed to preserve it.

The greater part of the product put up on this coast goes to Europe, Germany being the principal consumer, but considerable quantities are sold in Norway, Sweden, and other countries, while the smokers of the cities east of the Rocky Mountains use large quantities every year.

In Germany, the principal market for mild-cured salmon, nearly all of the fish are smoked. One of the most popular ways of using the smoked salmon is in the making of sandwiches, and probably the greater portion of these are used in the beer halls and the automatic restaurants in that country.

PICKLING

The earliest method of preserving salmon on the coast was by pickling. At times this industry attained to large proportions, but during the last 10 years it has been declining, largely because the canners are able to pay more for the raw fish than the salters. All species of salmon are pickled, but the most popular is the red salmon.

In dressing salmon for pickling the head is removed, the fish split along the back, the cut ending with a downward curve on the tail. The viscera and two-thirds of the backbone are removed, and the blood, gurry, and black stomach membrane scraped away. The fish are then thoroughly scrubbed and washed in cold water. They are next placed in pickling butts with about 15 pounds of half-ground salt to every 100 pounds of fish. The fish should be laid in a tier, flesh side up, and the salt well sprinkled over it, repeating until the tank is full. Several boards are then laid across the fish and these are weighted down with large stones in order to keep the fish submerged in the pickle which will form. The fish remain here about one week, the brine being held at about 90°. They are then removed, rubbed clean with a scrub brush, and repacked in market barrels, one sack of salt being used to every three barrels of 200 pounds each. About 40 to 52 red salmon, 25 to 35 coho salmon, 70 to 80 humpback salmon, 10 to 14 king salmon, and 25 to 30 chum salmon are required in packing a barrel of pickled salmon.

A few salteries also pack "bellies." This product is merely the belly of the fish, which is the fattest portion, and as most of the packers threw away the rest of the fish, thus causing a very large waste of choice food, this method has come under the ban of the law in some of the coast States and in Alaska. As a result, but few "bellies" are packed now, and most of these only when some economic use is made of the remainder. Humpback salmon furnish the major part of the "belly" pack.

In preparing salmon bellies, the operator first cuts off the two pectoral fins, and then removes the head, care being taken to follow the curve of the body until the backbone is reached, which should then be severed straight across. With the smaller salmon the fish is then turned on its back, and the operator inserts his knife in the body just above the backbone and cuts down through the body, the knife coming out just in front of the vent. If properly done, the cut will come close to the upper wall of the stomach. With large king salmon it is sometimes necessary to make the cut first on one side, then turn the fish over and make the cut on the other side. The belly is then laid flat on the cutting table and the membrane at one end cut so the belly will lie flat. The bellies are then washed and salted the same as hard-salted salmon.

When bellies are cut, the backs are saved and either dried in the open air, without salt, or else pickled.

With large kings, the operator, after the belly has been cut out, scrapes the inside of the remainder of the carcass. The knife is then inserted under the backbone at the end nearest the tail, and it is cut away with as little flesh as possible adhering to it. The blood is then scraped off, the fish thoroughly washed, and then salted the same as the whole fish.

Some of the old-time fishermen save parts of the salmon heads as food. In this event, the head is split lengthwise clear to the bony covering which protects the top of the head. The gill rakers are then removed from each side of the split head, leaving the nutritious parts intact. The cleaned heads are then salted down the same as whole salmon.

DRY SALTING

During the progress of the Russian-Japanese War the preparation of dry-salted chum salmon became an important industry, but as soon as the Japanese fishermen resumed their former occupations the demand fell off so much that the industry was virtually abandoned in the United States, although a number of Japanese continue it in British Columbia. The fish, after being dressed, were packed in boxes, in salt, these boxes holding about 560 pounds of fish, and were shipped in this condition to Japan.

At a number of places in Alaska the bellies of red and coho salmon are cut out and salted, after which the backs are dried in the sun and, thus cured, are used for fox food at the numerous fox ranches. This product is called "ukalu."

SMOKING

The smoking of salmon is virtually a continuation of the pickling, as the fish must be pickled before being smoked, the main purpose of the pickling being to preserve them until the time arrives for smoking, which may be weeks or months after the fish are caught. For smoking the salmon are taken out of the barrel and soaked until as much of the salt as possible is removed. They are then put into the smokehouse and subjected to the heat and smoke of a fairly hot fire for about two days in order that they may be thoroughly dried and hardened. Exposure to a smoldering fire (alder wood is a favorite fuel) for about three days completes the process.

For shipment smoked salmon are packed in wooden boxes, oil paper being placed between the fish.

In the manufacture of smoked salmon, the mild-cured product is most in demand. The necessary quantity of sides is taken from the cold-storage and placed in large tanks filled with fresh water. In these they are soaked over night, the water being changed several times, depending upon the salinity of the fish, the variation of which depends upon the length of time the product has been held in storage, those held longest absorbing the most salt.

After soaking, the sides are taken from the tanks, piled on tables, and allowed to drain as much as possible. They are then taken one at a time, laid flesh side down, and a bacon hanger, which is made of wire and has six or more points bent at right angles to the frame, terminating at the top in a hook, is pressed firmly into the flesh on the skin side and at the upper end of the side. They are then hung upon a round stick, which latter is then set in position in the smokehouse, each end resting upon supports on the side. The fish are placed so that no two of them will touch. When the smokehouse is full, a small fire of any nonresinous wood is then built underneath to dry them, the ventilator in the top being left open so the moist air can escape. The fires should not be allowed to become too hot; the object is to give the fish smoke rather than heat, as in the latter case they would become partially cooked. For a mild cure, for ready consumption, from 8 to 10 hours, according to the condition of the fish, should be sufficient. If immediate sale should not be possible the fish must be kept in a cold-storage room with a temperature of about 24° F.

In sections where the products move more slowly into consumption, a harder smoking is wanted. In this event, they are held over the fire until dried, which would depend upon climatic conditions, but probably around two days. After the fish have dried sufficiently, the fire is smothered with sawdust, which produces a dense smoke, giving the sides their color. During the latter period the ventilator is partly closed, but must be watched to prevent the fish from sweating.

When thoroughly smoked the sides are removed from the smokehouse, taken off the hanger, and each side wrapped in paper, then packed in wooden boxes holding each 30 pounds.

Kippered salmon.—On the Pacific coast practically all of the kippered salmon is prepared from frozen white-meated king salmon, which on account of the color of the flesh is not in much demand. It is, however, fully the equal, in both flavor and food value, of the red-meated kings. It is not absolutely essential that the fish be first frozen, as the fresh fish may be kippered after dressing, but the latter is always a little soft when so prepared, owing to an excess of moisture, which is largely removed in freezing. Fresh salmon is available only part of the year, so it is found most convenient to freeze and store the stock and work it up when needed throughout the year.

Before freezing, the fish have been dressed, so, when thawed in cold-running water, it is only necessary to split and cut them into pieces of a pound or less, these being about 6 inches long, or perhaps 3 inches broad, depending upon the part of the fish the piece is taken from, and place them in a tank of strong brine to season for several hours. They are then dipped in a harmless vegetable coloring, similar to that used by the butchers for coloring sausage; this gives the outside of the product a red color, a concession to popular prejudice.

From the coloring tank, the pieces are placed on a tray with wood frame and bottom of one-half inch square meshed wire; care is taken that the pieces do not touch each other.

The tray is then slipped into a rack which will hold a number of these, placed one above the other, and this rack is then run on a track into the smokehouse.

A medium fire is then kindled which dries and slightly smokes the pieces from 16 to 18 hours.

When they reach a proper stage the fire is enlarged, but great care must be exercised in order to prevent their being overheated, and this is done by means of the damper at the bottom of the smokehouse and the ventilator at the top. The fish are baked in this manner from 25 to 35 minutes, the thermometer showing from 250 to 275° of heat.

When the cooking is completed the cars are pulled out and the fish allowed to cool, after which each piece is wrapped in a square of parchment paper and packed in a box or basket which holds 10 pounds.

The product is quite perishable, and if it can not be used at once, when of course it is at its best, must be placed in cold storage. The packer endeavors to turn out daily only the amount he can market that day.

Beleke.—A smoked product, known locally as "beleke," is put up at Kodiak, Alaska, from red and coho salmons. Steelhead trout are the best for this purpose, but are not often utilized owing to their scarcity in this region. In preparing "beleke" only the backs of the fish are used, the belly part being cut out and pickled separately. The backs are divided into three grades, according to size, viz, "small," "medium," and "large." They are first put into a brine, the "large" being put in first, followed by the "medium" and "small" at intervals of one hour each, so that all will be cured at about the same time. The coho backs, being the largest, are kept in the brine from 19 to 20 hours, while the red salmon backs, which are smaller, remain in the brine only about 16 hours. After being thoroughly salted the backs are removed from the brine and rinsed in fresh water, then hung in the air for about 24 hours to dry and to allow a thin skin to form on the outside. They are then hung in the smoke-house, in the presence of a little fire of cottonwood or alder. On dry days the gable windows are thrown open and the wind allowed to pass through while the smoking is going on. The smoking must be done slowly, two weeks being devoted to it.

There is a good demand for this product locally, the fish selling for from 15 to 20 cents a pair, but little effort has been made to extend its sale outside of central Alaska.

FREEZING

The process of preserving fish by freezing was first introduced in 1888. Previous to this the comparatively ancient method of packing with ice, or in rare instances letting the fish freeze naturally during the winter months, was followed. Packing with ice is in quite general use to-day for shipments of fish which are to be preserved for short periods of time. Cooling with ice never results in a temperature lower than 32° F., which, of course, does not freeze the fish.

The freezing of salmon and steelhead trout began on the Sacramento and Columbia Rivers in the late eighties. It was taken up in a small way on Puget Sound in 1892. That year Wallace Bros. and Ainsworth & Dunn froze a small lot, the work being done for them by the Seattle Ice Co. (now the Ice Delivery Co.), and the venture was so successful that the next year nearly all of the wholesale dealers on the Sound took up the business. The Crescent Creamery, of Tacoma, also engaged in the business for the fish dealers for a year or two shortly thereafter. In 1902 the British Columbia Packers Association bought a large cold-storage plant at New Westminster, British Columbia, at that time the only large and modern plant in the Province, and began the active freezing of fish. Since then a number of excellent plants have been built and operated. In Alaska the preparing of frozen salmon began in 1902. The San Juan Fishing & Packing Co., soon to be succeeded by the Pacific Cold Storage Co., put up a cannery and cold-storage plant at Taku Harbor, in southeast Alaska, in 1901, though it did not operate the cold-

FIG. 38.—SHIP, "WM. H. SMITH," FLOATING CANNERY AND COLD-STORAGE PLANT

FIG. 39.—SALMON OFFAL READY FOR DELIVERY TO THE FERTILIZER AND FISH-MEAL PLANTS

storage portion until 1902. The Taku Harbor Canning & Cold Storage Co. later on succeeded to the ownership and operation of this plant. This is the only plant which was operated in Alaska until the New England Fish Co. erected in 1909 a large plant at Ketchikan for the freezing of halibut primarily, but considerable quantities of salmon have been frozen also.

In 1911 the schooner *Metha Nelson* was fitted up as a floating freezer by the Alaska Packers Association and sent to Kodiak Island. As the vessel arrived in San Francisco shortly before the State's closed season on salmon began, and it was a difficult matter to dispose of the catch before then, the business was abandoned.

In 1912 J. Lindenberger (Inc.) opened a freezing plant at Craig, on Fish Egg Island, Alaska, while the ship *William H. Smith* was outfitted as a floating cannery and freezer by the Weiding & Independent Fisheries Co., at Saginaw Bay, Alaska. The latter operated only one season.

The year 1913 saw quite a development in the industry. The Columbia & Northern Fishing & Packing Co., at Wrangell, the Juneau Cold Storage Co., at Juneau, the Booth Fisheries Co., at Sitka, and the floating cold-storage ship *Glory of the Seas*, by the Glacier Fish Co., at Idaho Inlet, were all started this year.

In 1914 the Ketchikan Cold Storage Co. opened a freezer for the general commercial freezing of fish.

In 1917 the San Juan Fishing & Packing Co. built and operated a cold-storage plant at Seward.

In 1918 Henry Goemaere operated for the first time a plant at Washington Bay; while the National Independent Fisheries Co. and the Trout Fisheries Co. froze salmon at Ketchikan. All the other freezers operated as usual, the only change being the purchase by Libby, McNeill & Libby of the cold-storage plant and cannery of the Taku Harbor Canning & Cold Storage Co. at Taku Harbor.

The freezing of salmon is almost invariably carried on in connection with other methods of handling and preserving, and the purpose is usually to secure the fish when numerous and cheap, freeze them, and then hold them until the runs are over and the fish are once more in good demand at high prices. The business proved so profitable, however, that the dealers began to look for wider markets for their product. Europe, more especially Germany, was prospected and a profitable market soon developed, with the result that to-day frozen Pacific salmon can be secured in nearly every town of any size in western Europe, while large quantities are marketed all over our own country.

There are four important features in packing and using frozen salmon: (1) To get fresh fish; (2) to keep them cold (about 15° above zero) after they are frozen; (3) to keep a coat of ice on them; and (4) to allow them to thaw slowly in cold water or in the air before cooking.

In selecting salmon for freezing, only the finest and freshest of each species are used. The current belief that freezing destroys the flavor of the fish is erroneous, the flavor depending entirely upon the condition before freezing, and the quicker they are frozen after being caught the better will the natural flavor of the fish be preserved. Frozen salmon are just as wholesome as fresh, and their chemical constituents are almost identical. The danger lies in the temptation to freeze the fish after decomposition has set in, but, fortunately, this is now very rarely practiced in the salmon industry.

The coho, or silver, and the chum, or keta, salmon are the choicest of the salmons for freezing. The other species, except the red, or sockeye, which is too oily and rarely frozen, are also frozen in varying quantities. The steelhead trout, which is ranked by the Pacific coast dealers among the salmon, is considered the choicest fish of all for freezing.

Some of the most modern plants in the country are on this coast. These have numerous freezers, generally, in which a temperature of from 25° to 30° F. below zero can be maintained if desired, although a temperature of more than 10° below zero is rarely ever required. All freezing is by direct expansion and each freezer is piped with about 2 feet of 1¼-inch pipe per cubic foot of freezing space. The bunkers in the freezers are in pairs, generally nine pipes wide, spaced 10 inches apart. This leaves about a 3½-foot passage through the center of each freezer opposite the swing doors. The salmon are laid on metal sheets, which are placed on the tiers of pipes.

After freezing the salmon are passed through openings in the rear of the freezers into the glazing room, which has a temperature of about 20° F., where they are dipped into water, and when removed are covered with a thin glaze of ice, which may be thickened by repeated dippings. This is an extra precaution to exclude the air from the fish.

After being thoroughly frozen and glazed, each fish is covered first with a parchment, like rolls of butter, and then with a piece of heavy brown paper. They are then packed in boxes holding about 250 pounds each, placed in cold-storage cars and shipped.

UTILIZING SALMON EGGS AND MILT

Every year immense quantities of salmon eggs are thrown away in the fisheries of the west coast, though there is but little doubt that, if properly prepared, a market could in time be found for this now waste part of the fish. In France there is a good market for a product known as "rogue," which is the spawn of cod, haddock, hake, and pollock, salted in casks, and which is used as bait in the sardine fisheries. Salmon spawn is the choicest and most successful bait used on this coast, and if properly prepared would undoubtedly answer the purpose as well as the regular "rogue" if not better, owing to its oiliness and attractive color. The roes should be soaked for some days in old brine and then packed in strong casks holding about 25 gallons each. It might also prove to be a good bait for tolling mackerel on the Atlantic coast.

In 1910 a considerable quantity of salmon roe was prepared in Siberia and sold in competition with caviar, which is prepared from sturgeon eggs. The product met with favor in Europe and now large quantities are prepared each season.

In this country Miss Ida Tuholski, of San Francisco, who had been engaged in the preparation of sturgeon caviar for some years, put up a number of sample lots of salmon caviar which are fully the equal of the best sturgeon caviar. Capital has been chary, however, about engaging in the business, although undoubtedly it will be an important industry some day. During the last five years several firms, notably the Neptune Fish Products Co., of Seattle, have successfully taken up the business of caviar making.

For making caviar the eggs should be as fresh as possible, and in order to make sure of this the salmon are taken alive, if possible, shortly after coming from the water, killed and bled, the belly opened up and the roe taken out. This work can best be done on work and living scows anchored close to the fishing camps. The roe is placed upon a stand, the top of which is formed of a small-meshed galvanized iron wire screen. On the underside is arranged a zinc-lined trough. The operator gently rubs the mass of eggs back and forth over the screen, the mesh of which is just large enough to let the eggs drop through, and, as they are separated from the membrane by the rubbing, they fall through into the trough and are thence drawn off into tubs by means of a sliding door at the end of the trough.

After all the roe has been separated the tub is removed and a certain proportion of salt (the sturgeon caviar makers employ the best Luneburg, Germany, salt in this work, while some of the Siberian makers of salmon caviar use No. 2 Berkshire salt from England) is added to the roe, after which the mass is mixed with the hands. The most delicate part of the whole operation is in the manner of mixing. No direct rule can be given for doing this portion of the work, as the condition of the roe regulates the time consumed and the manner of handling. It requires practical experience to become proficient, but this should be an easy matter for one used to handling salted products. The sturgeon caviar makers use about 11 pounds of salt in preparing a keg of caviar.

After the salt has been added the mass of eggs first dries up, but in a few minutes the strength of the salt draws from the eggs their watery constituents and a copious brine is formed, which can be poured off when the tub becomes too full. In Siberia the caviar makers put the eggs into a brine solution of 19 to 22 per cent Baumé strength immediately after they come from the trough. The salted eggs are then poured into very fine-meshed sieves which hold about 10 pounds each. In the caviar house are arranged long, sloping boards with narrow strips nailed on each side. On these the sieves are placed and left here from 8 to 20 hours in order to thoroughly drain.

The Siberian caviar makers hasten the operation by putting the eggs into a brine solution as noted above, leave them there for from 25 to 45 minutes, then place them in bags and subject them to heavy pressure, after which they are packed. While this method occupies less time, it is not thought the resulting product is as good as that prepared by the slower method outlined above.

The eggs are then transferred to small casks (holding about 135 pounds). The sturgeon caviar makers use oak or pine casks, but some of the Siberian makers say that oak casks turn the salmon caviar black. The casks are steamed before use in order to prevent any possible leakage. It is especially necessary that the kegs or barrels used be air-tight, as otherwise the product will spoil. Barrels such as used in packing salt salmon are rarely ever tight enough to hold caviar. The casks are covered and allowed to stand until the gas escapes and the eggs settle. The vacant space caused by the settling is then filled, the cask headed up and put in a cool place until ready for shipment.

The Siberian salmon caviar makers use a small quantity of "preservaline" in each keg for the purpose of aiding in preserving them, as cold-storage facilities are quite primitive as yet in that country, and it is the addition of this powder which forms the mysterious part to the uninitiated. No preservative would be needed in Alaska, however, as the kegs could be shipped in cold storage along with the mild-cured salmon.

A number of establishments are putting up these eggs in jars and hermetically sealed cans for use as bait in sport fishing.

In 1916 one of the companies operating in Alaska put up some salmon milt in cans. No difficulty was experienced in canning this product and it met with considerable favor from those who tried it, but nothing has been done with it since.

Recently a Seattle company has been obtaining and preserving the eggs of silver and chum salmon and selling them to fish-cultural establishments to be used in feeding the young fish. As these are usually too large for feeding to the young fry, a method for dehydrating them was worked out in the laboratory of the College of Fisheries, University of Washington. When dehydrated the eggs could be fed directly to all sizes of hatchery-reared fishes; when intended for young fry the dehydrated eggs would be crushed up to a coarse powder which the fish found no trouble in swallowing. Experiments covering some months showed that the fry and others thrived on salmon eggs as food prepared in any of the ways noted in this paragraph.

MISCELLANEOUS PRODUCTS

A few years ago a company on the Columbia River put up what was known as "fish pudding." In preparing this the salmon was ground fine, mixed with milk and eggs, and then packed in tin cans. The preparation was soon abandoned.

In 1903 one of the Point Roberts canneries packed a new product which was called "salmon paste." For this the fish was ground up, cooked, seasoned with spices, etc., and made into fish balls, a very palatable dish when warmed over.

In 1905 a Seattle concern began the manufacture of wienerwurst sausages from halibut and salmon.

A Columbia River plant has also recently begun the preservation as food of the livers of the salmon.

The Indians in the Bristol Bay region of Alaska occasionally dress the skins of salmon and make of them leather for the tops of boots, also bags and other small articles.

A product, which was first made in Norway, is prepared by means of an invention which quickly dries and pulverizes the flesh of fresh fish. The resulting powder, called "fish flour," is easy to transport from one place to another and has great nutritive value. It is probable that the tailpieces of the fish, which are at present thrown away, and the cheaper grades of salmon might be prepared in this way and thus furnish another market for salmon.

MEAL, FERTILIZER, AND OIL

As early as 1888 there was a small plant at Astoria, Oreg., where the refuse of the canneries was utilized for the manufacture of oil and fertilizer. In that year 8,000 gallons of oil (chiefly from salmon heads) and 90 tons of fertilizer were prepared. The oil was worth 22½ cents per gallon and the fertilizer had a market value of $20 per ton. Most of the refuse was dumped into the river, however. In 1898 a similar plant was established in the Puget Sound district of Washington. In 1929 the Alaska Packers Association at Blaine, the Marine Products Corporation at Everett, the Neptune Fish Products Co. (Inc.) at Seattle, the Robinson Fisheries Co. at Anacortes, the Sea Products Co. at Seattle, and the United States Sea Products Co. on Lummi Island operated on waste from Puget Sound salmon canneries.

In 1882 the Alaska Oil & Guano Co. established a fertilizer plant at Killisnoo, Alaska, for the extraction of oil and fertilizer from herring and the plant has been operated continuously ever since. In some years large quantities of whole salmon have been handled at this plant, and the resulting product was found to sell as well as that from herring.

In Alaska the Fish Canners By-Products (Ltd.) in 1914 built a large plant at Ward Cove, near Ketchikan, where salmon offal was used in the preparation of fertilizer, meal, and oil. Later the company experimented in the preparation of various chemical products from the raw material. The plant has not been operated since 1920.

Probably the most serious evil in the salmon industry to-day is the enormous wastage which annually occurs. About one-fourth of the total weight of each fish handled at the various packing plants is thrown away. With the exception of the tailpiece, which is discarded at some canneries owing to the excessive amount of bone which would be in the product if canned, this waste material could not be utilized as food, comprising as it does the head, viscera, fins, and tail. When not conveniently near the very few fertilizer plants at present in operation this product is either allowed to pass through chutes into the water under the cannery or is dumped into scows and towed to the ocean or the deeper waters of the sounds and there thrown overboard. This procedure is not only exceedingly wasteful, but is also far from beneficial to the waters where deposited.

A great impetus has been given to the industry during recent years, owing to the big demand which has come from the farmers and poultrymen for fish meal or scrap, which, after it has been mixed with other ingredients, can be fed to cattle, hogs, and poultry. Experiments carried out at various agricultural experiment stations, both here and in Europe, show conclusively that this class of food increases the appetite of the animal, and consequently the weight, while it does not affect the flavor of the flesh of the animals.

As a result of this profitable demand a number of salmon canneries have installed small reduction outfits at their plants, where all of the hitherto wasted products are handled and the oil and meal obtained. It will probably be only a few years now before all of the canneries are so equipped.

SHIPPING FRESH SALMON DIRECT TO CONSUMER

A feature in the salmon industry is the shipping of individual salmon direct to consumers by express, or, for certain short distances, by parcel post, for a certain fixed sum, which includes the fish itself and the cost of delivering same to the buyer.

This business began in Tacoma, Wash., in 1914, and those who originated it advertised throughout the country that they would ship a fresh salmon to any express office in the United States (except

Southern Express), express prepaid, for $1.25, weight 7 to 8 pounds. In 1915 the cost, delivered east of the Mississippi River, was raised to $1.50 each, the old rate of $1.25 still being in force for shipments west of the Mississippi River. The price has since been increased. The business is now carried on from a number of places in Washington, Oregon, and California.

In shipping an individual fish, it is packed in a box containing 20 pounds of cracked ice. These boxes are collected by the express companies and are generally sent out in their own regular cars attached to trains leaving in the evening. About every 15 to 20 hours the box is opened and from 5 to 7 pounds, depending upon the weather, of cracked ice added to the box to make up the loss through melting.

As the Post Office Department will not accept packages in which ice is used for preserving fish, the use of the parcel post for shipments of individual fish is limited to the first postal zone (up to 50 miles from the initial point), except in winter, when the postmasters are authorized, in their discretion, to accept shipments for the second zone (50 to 100 miles from the initial point). In making fresh-fish shipments by parcel post, frozen fish are generally used.

Most of the orders come from the Middle West, where fresh fish are not abundant, but orders are received from all sections of the country.

The success met with in shipping fresh salmon led to a considerable expansion of the industry, with the result that now one can obtain not only a fresh salmon, but also may purchase salt, smoked, and kippered salmon, salt codfish, and fresh halibut, smelt, crabs, and other sea food in their season.

NUTRITIVE QUALITIES OF SALMON

More and more attention is being paid by the consuming public to the nutritive qualities of the food products offered them, and this is especially true as regards fishery products.

The proper functions of food are twofold, first, to furnish protein for building and repairing the body, and, second, to supply energy for heat and muscular work. Foods which supply an abundance of both at a reasonable price are of the greatest importance from an economical standpoint.

ANALYSES OF CANNED AND FRESH PACIFIC SALMON

Despite the great prominence of the salmon industry, but little time has been devoted to it by the chemist.

Prof. W. O. Atwater was the first American investigator to devote any portion of his energies to the analysis of Pacific salmon. In Principles of Nutrition and Nutritive Value of Food (Farmers Bulletin No. 142, United States Department of Agriculture, 1901), he gives the following analysis of canned Pacific coast salmon:

> Water, 63.5 per cent; protein, 21.8 per cent; fat, 12.1 per cent; ash, 2.6 per cent; fuel value per pound, 915 calories.[34]

C. F. Langworthy, in Fish as Food (Farmers Bulletin No. 85, United States Department of Agriculture, 1898), gives the following analyses of fresh and canned Pacific coast salmon:

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[34] The unit used to show the fuel value is the "calorie," which is the amount of heat required to raise the temperature of about 1 pound of water 4° F.

Fresh salmon, California (sections): Refuse (bone, skin, etc.), 5.2 per cent; water, 60.3 per cent; protein, 16.5 per cent; fat, 17 per cent; mineral matter, 1 per cent; total nutrients, 34.5 per cent; fuel value per pound, 1,025 calories.

Canned salmon: Refuse (bone, skin, etc.), 3.9 per cent; salt, 1 per cent; water, 59.3 per cent; protein, 19.3 per cent; fat, 15.3 per cent; mineral, 1.2 per cent; total nutrients, 35.8 per cent; fuel value per pound, 1,005 calories.

Dr. Harvey W. Wiley gives the following as the composition of a Pacific coast salmon (species not given):[35]

Fresh—Water, 63.61 per cent; protein, 17.46 per cent; fat, 17.87 per cent; ash, 1.06 per cent. Dry—Protein, 52.31 per cent; fat, 49.05 per cent; ash, 2.92 per cent.

On page 137 of the same work Doctor Wiley gives the following as the mean of three samples of Pacific coast canned salmon:

Composition of canned salmon.—Mean of three samples. Water-free substance: Protein, 53.52 per cent; fat, 40.52 per cent; ash, 6.24 per cent.

Professor Knisely,[36] of the Oregon State Agricultural College at Corvallis, Oreg., analyzed canned salmon packed at the Funter Bay (Alaska) cannery of the Thlinket Packing Co., with the following results:

Species	Moisture	Protein	Fat	Ash
	Per cent	*Per cent*	*Per cent*	*Per cent*
Sockeye or red	64.74	24.19	9.11	2.06
Coho or medium red	68.22	26.56	3.61	1.66
Humpback or pink	69.43	24.00	4.86	1.68
Keta or chum	67.08	25.06	6.59	1.26

H. M. Loomis, formerly chief of the Seattle food and drug inspection laboratory, Bureau of Chemistry, United States Department of Agriculture, reports as follows on analyses of both canned and fresh Pacific salmon made at this laboratory.[37]

CANNED SALMON (1911 PACK) [a]

Sample	Water	Ethyl ether extract [b]	Protein (N×6.25)	Total ash	NaCl. [c]	Ammoniacal nitrogen: Richardson method	Ammoniacal nitrogen: Alcohol vapor method
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
No. 1. Puget Sound sockeye	62.44	15.17	20.25	2.50	0.79	0.0403	0.0348
No. 2. Puget Sound sockeye	61.84	13.74	21.77	2.73	1.10	.0437	.0410
No. 3. Alaska medium red	69.97	7.81	20.40	2.58	1.09	.04965	--------
No. 4. Alaska chum	73.48	2.88	21.33	2.57	.83	.0563	.0557
No. 5. Alaska pink or humpback	74.12	4.75	19.75	1.98	.50	.0404	--------
No. 6. Alaska red	70.88	5.26	21.79	2.35	.64	.0455	--------
FRESH SALMON (CAUGHT MAY 7, 1912), EDIBLE PORTIONS							
Puget Sound sockeye	67.48	8.86	22.24	1.36	--------	0.0121	0.0205
Puget Sound steelhead or salmon trout	67.89	9.39	21.80	1.35	--------	.0135	.0218

[a] Each sample is average of two or more cans. All samples, except No. 2, are old form 1-pound tall cans. No. 2 is ½-pound flat cans.
[b] Represents the fat.
[c] Represents the salt.

[35] Foods and their Adulteration, etc., p. 135. By Harvey W. Wiley. 8°, Philadelphia, 1907.
[36] Pacific Fisherman, Vol. VI, No. 1, January, 1908, p. 21.
[37] Salmon Canning Industry of North America. By H. M. Loomis. Original communications. Eighth International Congress of Applied Chemistry, Washington and New York, Sept. 4 to 13, 1912. Vol. XVIII, pp. 239–245. The Rumford Press, Concord, N. H.

The composition of the flesh of the five species of salmon differs somewhat. The following table from Bureau of Fisheries Document No. 1000 entitled "Nutritive value of fish and shellfish," Washington, D. C. (1926), gives the average of many analyses, together with analyses of steelhead trout and Atlantic salmon for comparison:

Composition of canned salmon

	Total solids	Fat	Protein (N×6.2)	Ash (inorganic matter)	Food value per pound
Pacific salmon:	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Calories*
Sockeye	35.22	11.22	20.80	1.23	860
Chinook	36.83	15.72	17.67	1.21	991
Coho	32.51	8.49	21.08	1.24	750
Pink	30.20	6.99	21.40	.76	696
Chum	29.96	6.69	20.67	1.02	514
Pacific steelhead trout	33.16	8.95	21.32	1.21	792
Atlantic salmon	35.70	12.49	21.14	1.22	920

NOTE.—For certain reasons the backbone and as much as possible of the rib bone were removed from these cans before analyzing, but ordinarily they are eaten and thus increase the valuable mineral constituents in the food.

ANALYSES OF CANNED SALMON BY SOUTH DAKOTA AUTHORITIES

In 1916 the South Dakota Food and Drug Department analyzed a considerable number of samples of canned salmon for the purpose of determining, if possible, whether inferior grades of the fish were substituted for the better grades, and for the further purpose of discovering some means of identifying the different types of salmon by chemical analysis.

Thirty-three samples of commercial canned salmon, including 30 different brands, were analyzed. Thirteen of these were labeled as belonging to the sockeye class, five to the coho, six to the humpback, and one to the chum. Five samples were not labeled as to variety. One sample was labeled "Salmon Steaks" and two samples were labeled "Fresh Alaska." The last eight samples, because they were not labeled to show the common name of the fish contained in the can, were in violation of the F. I. D. No. 105 referred to above.

All of the cans but one were labeled to show the net weight of fish in the can. Sixteen per cent of them contained less than the declared amount of contents, but the greatest shortage was but 3.1 per cent of the declared weight, while the greatest excess in weight was 18.7 per cent of the declared weight. The weight is usually stated considerably under the actual amount of the contents.

The amount of liquid in the cans is an important factor to consider in computing the value of the contents. The free liquor in the cans examined varied widely from 3.95 per cent in sample number 15–209, labeled "Salmon Steaks" to 26.54 per cent in sample number 15–63, which was not labeled as to variety. As a rule, the largest amount of free liquor is found in the lower priced grades, but there are exceptions, notably number 15–70, which contained 24.14 per cent of free liquor.

It will be noticed from the results given in the table that the amount of total moisture varies inversely as the amount of fat (called ether extract in the table). That is, salmon containing an excessive amount of moisture contains little fat, but those samples which contain the lower amounts of moisture contain the largest amounts of fat. The protein content seems to be fairly constant in all samples, the average amount being 19.34 per cent, while the minimum found is 15.66 per cent and the maximum 22.45 per cent. The total phosphoric acid varies from 4.2 per cent to 9.8 per cent, the average being 6.6 per cent.

As would be expected, the samples containing the larger proportions of fat liberate the larger quantities of heat units, or calories, per pound, and it will be noted that the price is not in all cases an accurate measure of value, some of the higher priced varieties being in reality much lower in actual cost, when their food value is taken into consideration, than some of the cheaper varieties.[38]

[38] Bulletin, South Dakota Food and Drug Department, Vol. IV, Nos. 2 and 3, October-December, 1916, pp. 8–11.

The table below has been condensed from that shown in the report. The brand, name of the jobber, and the data about these samples, where the species is not shown on the label, have been eliminated, as they were not essential to our purpose. All of the other data have been reproduced exactly as they appeared in the original report. Not a single one of the samples apparently bore the packer's label, all being jobber's labels.

Laboratory No.	Variety	Total moisture	Ether extract	Protein	Ash	
					Soluble	Insoluble
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
15-56	Red	52.32	17.68	19.50	2.15	0.81
15-210	Fancy sockeye	59.29	16.83	18.28	1.63	.88
15-209	Salmon steaks	60.45	17.96	17.31	1.47	.33
15-60	Fancy red	60.46	15.40	18.22	1.33	2.89
15-72	Sockeye	60.80	18.19	19.15	.81	.78
15-65	do	60.95	15.94	18.56	1.50	1.11
15-59	Red sockeye	61.60	15.48	16.89	1.99	.57
15-64	do	62.18	13.10	19.13	1.45	.65
15-204	Red Alaska	65.44	10.57	20.31	2.15	.51
15-58	Coho salmon	65.65	9.62	17.32	1.61	1.33
15-220	Red Alaska	66.12	8.63	21.22	1.73	.62
15-64	Coho salmon	67.18	9.59	17.60	1.18	1.20
15-222	Pink salmon	69.53	6.62	20.48	1.85	.78
15-219	Red salmon	69.87	6.36	20.38	2.24	.57
15-207	Pink salmon	70.45	7.28	17.66	1.53	.90
15-221	Chum	70.52	4.57	19.73	.80	.72
15-205	Red salmon	70.86	4.04	21.11	1.60	1.13
15-70	do	71.45	4.47	20.75	2.15	1.60
15-61	Pink salmon	71.64	4.35	18.31	1.56	1.01
15-208	Gorbouscha [1]	73.17	5.33	17.35	1.27	.45
15-206	Alaska salmon [2]	73.30	2.43	21.22	1.45	.96
15-214	do	73.76	3.98	18.31	1.62	.54
15-57	Pink Alaska	74.08	3.90	15.66	1.50	1.02

Laboratory No.	Variety	Phosphoric acid [3]		Sodium chloride	Calories per lb.	Price per lb.
		Soluble	Insoluble			
		Per cent	*Per cent*	*Per cent*	*Number*	*Value*
15-56	Red	4.2	3.5	1.45	1,110	$0.31
15-210	Fancy sockeye	4.2	4.0	.81	1,050	.30
15-209	Salmon steaks	3.7	1.5	.51	1,080	.36
15-60	Fancy red	2.8	3.8	.53	990	.29
15-72	Sockeye	3.1	3.7	.14	1,125	.25
15-65	do	2.2	5.3	.68	1,020	.29
15-59	Red sockeye	3.6	2.6	1.10	965	
15-64	do	3.2	3.5	.60	910	.30
15-204	Red Alaska	4.0	2.3	1.15	825	
15-58	Coho salmon	2.5	5.7	1.02	730	.25
15-220	Red Alaska	1.9	2.8	.82	760	
15-64	Coho salmon	2.4	5.9	.53	730	.21
15-222	Pink salmon	1.8	3.6	.90	660	
15-219	Red salmon	2.0	2.7	1.26	545	
15-207	Pink salmon	3.4	4.1	.74	635	.15
15-221	Chum	1.0	4.1	Trace.	565	
15-205	Red salmon	3.3	3.2	.65	560	.30
15-70	do	2.7	3.1	1.17	575	.30
15-61	Pink salmon	2.4	4.7	.84	525	.15
15-208	Gorbouscha [1]	2.9	2.1	.45	550	
15-206	Alaska salmon [2]	2.7	4.4	.66	500	.15
15-214	do	1.7	2.5	.75	510	.15
15-57	Pink Alaska	2.0	4.5	.85	455	.25

[1] Probably pink salmon (author). [2] Probably chum salmon (author). [3] Mgm. of P_2O_5 per gram.

ANALYSIS OF SALTED SALMON

Falkenburg & Co., of Seattle, have recently made an analysis of the food value of salted salmon, as follows: [39]

Regarding the salmon recently inspected and analyzed for you by ourselves with the following results:

Protein	21. 97 per cent
Fat	4. 34 per cent
Salt	19. 08 per cent
Ash	. 84 per cent
Moisture	54. 35 per cent
Calories per pound	592

If this salmon were freshened, as is the custom in preparing it for the table, removing all but about 2 per cent of the salt, the fish would then have the following analysis:

Protein	27. 13 per cent
Fat	5. 36 per cent
Salt	2. 47 per cent
Moisture	65. 11 per cent
Ash	1. 03 per cent
Calories per pound	734

Bulletin No. 28 of the United States Department of Agriculture, "Chemical Composition of American Food Products" gives on page 51 the food value of the average canned salmon as purchased as follows:

Refuse	14. 2 per cent
Protein	19. 5 per cent
Fat	7. 5 per cent
Ash	2. 0 per cent
Moisture	56. 8 per cent
Calories per pound	680

SALMON IN RELATION TO THE PREVENTION OF GOITER

Goiter is a deficiency disease of man and animal manifested as an enlargement of the thyroid gland—the large gland in front of the neck. There are two types of goiter, one form being easily recognized as a striking enlargement of the thyroid, often accompanied by "pop-eyes." This type of the disease is known as exophthalmic goiter. The second and most important type in regard to incidence is marked only by a slight swelling at the base of the neck.

It is a disease world-wide in distribution, but is most prevalent in the Temperate Zone. The goiter zone of North America stretches from coast to coast and includes southern Canada and the northern States of the United States, particularly the mountain and Great Lake regions.

Goiter has its greatest incidence among children. The rate of incidence increases as the age of puberty is approached, then falls off rather rapidly. Fifty per cent of the school children are affected in some localities. Women are particularly susceptible to goiter. In certain regions the goiter rate among women is six times greater than that of men. Statistics on the presence of goiter among its students have been collected at the University of Washington since 1908. During that time an average of 35 per cent of the women students have showed the presence of goiter. The percentage has been steadily reducing for some time past owing to the adoption of prophylactic and remedial measures. If it were not for this the average percentage would probably be higher.

[39] Pacific Fisherman, Seattle, Wash., Vol. XVII, No. 4, April, 1919, p. 76.

Goiter affects other animals as well as man. Horses, cattle, sheep, and pigs are affected by thyroid diseases in districts where goiter is prevalent in man. It is a serious economic problem. Before the cause was well known the majority of young farm stock born in certain goitrous regions died from this disease. The mortality has averaged as high as 90 per cent. It has been found that a goitrous condition in livestock could be prevented by feeding fish meal made from salmon and herring offal, or other sea fish containing a good deal of iodine.

A prophylactic treatment is effective in the treatment of goiter. Graphic illustration to prove the point is afforded by an article in the Canadian Medical Journal for May, 1924. Dr. W. D. Keith, the author, says:

> Situated at the lower end of the valley at the junction of these two rivers is an Indian reserve peopled by about 150 Indians whose forbears have lived in the same place as far back as the knowledge of man goes. In the Indian village no sanitation has been attempted and amongst these Indians there is no goiter nor has there ever been a case recorded. Only on rare occasions has a litter of myxœdematous pigs been born on the reserve.
>
> Whilst considering the lack of goiter amongst these Indians I would like to draw attention to the fact that they eat a great deal of salmon. The fish come up the Birkenhead to spawn, and many millions of eggs are secured at the Government hatchery a mile above the village. The Indians are allowed to use the spent salmon and annually cure thousands of fish for winter use. Their pigs also eat the dead salmon washed ashore on the gravel banks of the stream. It is quite probable that the Indians and their pigs get enough iodine from the salmon to give their thyroids the necessary quantum of this element.

It has been definitely proved that iodine exists in foods in quantity large enough to be effective as a goiter prophylactic. T. H. Von Fellenberg, of the Swiss Goiter Commission, has made a comprehensive study of the distribution of iodine in food, beverages, soil, and air. McClendon and Hathaway found that foods produced in goitrous regions contain less iodine than those produced in nongoitrous regions and come to the conclusion that "the recession of goiter that has taken place in New York State during recent times is due to the greater transportation facilities for sea food into the inland regions." Tressler and Wells, of the United States Bureau of Fisheries, published data on the iodine content of Atlantic coast fish in 1924.

The salmon fishery of the North Pacific is the most valuable of American fisheries, and its product has the widest distribution. Therefore it was thought advisable to undertake a very comprehensive research on the iodine content of the Pacific coast salmon. One or two sets of analyses could hardly be expected to furnish accurate data as to the iodine content when it is remembered that the industry is carried on from northern Japan to California.

This important research problem was undertaken by the College of Fisheries in collaboration with the northwest branch, National Canners Association, and was carried out by N. D. Jarvis, a member of the College of Fisheries faculty.

Samples used in this investigation were selected in such a way as to include representative samples of the five species of Pacific coast salmon and the steelhead trout which is closely related to the Atlantic salmon from as many canning districts as possible. The different species of salmon were also analyzed in a fresh condition in order to determine such things as a possible loss of iodine in canning or cooking by other methods. As a result it was concluded that there is no es-

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sential difference between the iodine content of fresh and canned salmon. One hundred and fifty-two different samples of fresh and canned salmon were analyzed for iodine content.

The results of this investigation, summarized briefly, are that salmon has an iodine content from twenty to fifty times that of fruit, vegetables, and milk, and that all canned salmon is a valuable source of iodine.

A variation in iodine content between species is indicated, the average of all analyses giving red salmon an iodine content of 0.405 milligrams per kilo (moist basis); chinook or king, 0.364; coho or medium red, 0.206; pink or humpback, 0.264 milligrams per kilo. The average iodine content of all species of salmon in all districts is 0.296 milligrams per kilo.

The iodine content apparently varies with the species and within the species, according to the district where the salmon is caught. It is also interesting to note that different parts of the same salmon vary in iodine content, the parts of the flesh richest in fat apparently having the most iodine. The roe has been found to have a particularly high iodine content, as much as 1.113 milligrams per kilo.

Attention has already been called to the observations of W. D. Keith on the freedom from goiter of a group of Indians in a particularly goitrous district, and his suggestion that this was possibly due to the fact that their diet included a large amount of salmon. This salmon, caught in a spawning condition, is far inferior to the article of commerce, taken at its prime.

In regard to this, Jarvis, Clough, and Clark, in an article published in the Journal of the American Medical Association, say:

> Salmon has at least equal grounds for consideration with milk products, fruits and leafy vegetables—the materials used in these experiments and found of value in the prophylaxis of goiter. Our results indicate a much higher iodine content in salmon than Fellenberg found in milk products, eggs, leafy vegetables, or fruits. A considerable part of the iodine in fruits is contained in such inedible portions as the rind and seeds. Canned salmon consists only of the edible portion, in which all the iodine may be utilized.
>
> It appears that the systematic use of sea foods which are rich in iodine would be of considerable benefit in the treatment of simple goiter or for its prevention in goitrous regions. Canned salmon, on account of its cheapness and availability, is particularly suitable and should be included in the diet for patients.

An estimate of the amount of salmon necessary in a diet for the prevention of goiter has also been made. The general average iodine content for all species in all districts may be given as 0.300 milligrams per kilo, or 300 parts per billion. The daily iodine requirement of the thyroid has been stated at approximately 0.01 milligrams. This amount of iodine is contained in 33 grams of salmon, if 300 parts per billion is taken as the average. An average sized portion of salmon or other sea food eaten three or four times a week should go far in helping to prevent goiter.

STATISTICS OF THE SALMON OUTPUT

CANNING INDUSTRY, 1864 TO 1928

SUMMARY OF CANNING INDUSTRY

From the beginning of the canning of salmon on this coast it has been the most important branch of the industry, and the following table shows in condensed form the number of cases packed in each year on the Pacific coast of North America from the beginning of the industry in 1864 to 1928, both inclusive.

As British Columbia is a Province of the Dominion of Canada, it does not come strictly within the scope of this report, but in order to show the pack of canned salmon on the North American shores of the Pacific Ocean, which would be incomplete without that of the Province, it has been included also.

Pack of canned salmon on the Pacific coast, by years and waters

Year	Puget Sound	Coastal streams of Washington	Grays Harbor	Willapa Harbor	Columbia River	Coastal streams of Oregon	Smith River, Calif.
	Cases	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*
1866					4,000		
1867					18,000		
1868					28,000		
1869					100,000		
1870					150,000		
1871					200,000		
1872					250,000		
1873					250,000		
1874					350,000		
1875					375,000		
1876					450,000		
1877	5,500				380,000	7,804	
1878	238		5,420		460,000	26,934	4,277
1879	1,300				480,000	8,571	
1880	5,100				530,000	7,772	7,500
1881	8,500				550,000	12,320	
1882	7,900				541,300	19,186	
1883	1,500				629,400	23,156	
1884	5,500				620,000	27,876	5,500
1885	12,000		8,200		553,800	33,410	1,550
1886	17,000		18,700	13,600	448,500	77,547	
1887	22,000				356,000	73,996	
1888	21,975		37,000	22,500	372,477	92,863	2,347
1889	11,674				309,885	98,800	
1890	8,000				435,774	47,009	
1891	20,529		500	8,000	398,953	24,500	
1892	26,426		16,500	14,500	487,338	83,600	
1893	89,774		22,000	16,195	415,876	52,778	2,000
1894	95,400		21,400	15,100	490,100	54,815	2,000
1895	179,968		11,449	22,600	634,696	77,878	2,250
1896	195,664		21,274	24,941	481,697	91,860	
1897	494,026		13,300	29,600	552,721	68,683	
1898	400,200		12,100	21,420	487,944	83,209	
1899	919,611		24,240	21,314	332,774	82,041	
1900	469,450		30,800	26,300	358,772	12,237	
1901	1,380,590		41,500	34,000	390,183	58,618	
1902	581,659		31,500	39,492	317,143	44,236	
1903	478,488			5,890	339,577	54,861	
1904	291,488		27,559	26,400	395,104	98,874	
1905	1,018,641		22,050	14,950	397,273	89,055	
1906	430,602		22,000	14,440	394,898	107,332	
1907	698,080		14,000	13,382	324,171	79,712	
1908	448,765		14,000	20,457	277,719	83,994	
1909	1,678,737		21,436	12,024	274,196	58,169	
1910	567,883		55,480	11,508	391,415	104,617	
1911	1,551,028	18,431	75,941	25,497	553,331	138,146	
1912	416,119	19,914	47,287	28,148	286,026	84,074	
1913	2,583,463	13,124	19,895	12,050	266,479	38,492	
1914	817,354	21,459	32,434	16,837	454,621	106,617	3,000
1915	1,269,206	31,735	40,992	12,842	558,534	80,499	3,033
1916	1,052,917	15,777	60,336	18,553	547,861	81,924	2,505
1917	1,990,258	13,324	42,696	8,379	553,346	84,475	6,300
1918	622,732	13,732	35,972	8,827	591,381	92,241	4,653
1919	1,295,626	4,942	45,296	13,204	580,028	76,218	4,366

Pack of canned salmon on the Pacific coast, by years and waters—Continued

Year	Puget Sound	Coastal streams of Washington	Grays Harbor	Willapa Harbor	Columbia River	Coastal streams of Oregon	Smith River, Calif.
	Cases	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*
1920	168,334	1,156	372	62	481,545	20,422	228
1921	589,847	2,956	5,544	5,166	322,120	15,754	3,000
1922	257,282	25,445	14,186	5,062	392,174	26,287	
1923	757,564	21,957	26,989	7,466	480,925	47,411	
1924	321,821	10,589	29,991	23,833	501,465	61,403	3,390
1925	906,993	7,805	29,684	33,071	540,536	55,686	7,700
1926	307,690	4,153	8,534	11,371	479,723	31,001	500
1927	892,244	6,680	12,839	21,793	519,809	45,035	2,300
1928	325,374	2,000	15,953	9,487	446,650	19,047	
Total	26,720,020	235,179	1,037,349	690,261	25,541,240	3,073,045	68,399

Year	Klamath River, Calif.	Eel River, Calif.	Noyo River, Calif.	Sacramento River	Alaska	British Columbia	Total
	Cases	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	*Cases* [1]
1864				2,000			2,000
1865				2,000			2,000
1866							4,000
1867							18,000
1868							28,000
1869							100,000
1870							150,000
1871							200,000
1872							250,000
1873							250,000
1874				2,500			352,500
1875				3,000			378,000
1876				10,000		7,247	467,247
1877		8,500		21,500		58,387	481,691
1878		10,500		34,017	8,159	89,946	639,491
1879				13,855	12,530	61,093	577,349
1880		6,250		62,000	6,539	61,849	687,010
1881				181,200	8,977	169,576	930,573
1882				200,000	21,745	240,461	1,030,592
1883		15,000		123,000	48,337	163,438	1,003,831
1884		8,200		81,450	64,886	123,706	937,118
1885		5,750		90,000	83,415	108,517	896,642
1886		12,500		39,300	142,065	152,964	922,176
1887				36,500	206,677	204,083	899,256
1888	4,400			68,075	412,115	184,040	1,217,792
1889				57,300	719,196	417,211	1,614,066
1890				25,065	682,591	411,257	1,609,696
1891				10,353	801,400	314,511	1,578,746
1892	1,047			2,281	474,717	248,721	1,355,130
1893	1,600			23,336	643,654	610,202	1,877,415
1894	1,700			28,463	686,440	492,232	1,887,650
1895	1,600			25,185	626,530	587,692	2,169,848
1896				13,387	966,707	617,782	2,413,312
1897				38,543	909,078	1,027,183	3,133,134
1898				29,731	965,097	492,551	2,492,252
1899	1,600			32,580	1,078,146	765,519	3,257,825
1900				39,304	1,548,139	606,540	3,091,542
1901				17,500	2,016,804	1,247,212	5,186,407
1902	2,500			14,043	2,536,824	627,161	4,194,558
1903				8,200	2,246,210	473,674	3,606,900
1904	3,400			14,407	1,953,756	465,894	3,276,882
1905				2,780	1,887,801	1,167,460	4,600,010
1906					2,219,044	629,460	3,817,776
1907					2,169,873	547,459	3,846,677
1908					2,606,973	542,689	3,994,597
1909	5,633				2,395,477	967,920	5,413,592
1910	8,016	6,000			2,413,054	762,201	4,320,174
1911	7,604	8,400		4,142	2,823,817	948,965	6,155,302
1912	18,000	11,000			4,054,641	996,576	5,961,785
1913	6,376			950	3,739,185	1,353,901	8,033,915
1914	11,000			17,315	4,056,653	1,111,039	6,648,329
1915	12,900			[2] 6,179	4,500,293	1,133,381	7,649,594
1916	8,884			[3] 19,445	4,900,627	995,065	7,703,894
1917	8,030			[4] 11,443	5,947,286	1,557,485	10,223,022
1918	10,200		2,000	4,036	6,605,835	1,616,157	9,607,766
1919	7,731		7,500	[4] 3,169	4,583,688	1,393,156	8,014,924

[1] Reduced to a common basis of forty-eight 1-pound cans to the case.
[2] Includes 950 cases packed at Monterey.
[3] Includes 12,809 cases packed at Monterey.
[4] Includes 2,000 cases packed at Monterey.

Pack of canned salmon on the Pacific coast, by years and waters—Continued

Year	Klamath River, Calif.	Eel River, Calif.	Noyo River, Calif.	Sacramento River	Alaska	British Columbia	Total
	Cases	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*
1920	11, 927	8, 472			4, 429, 463	1, 187, 616	6, 309, 597
1921	7, 376				2, 596, 826	603, 548	4, 152, 137
1922	9, 700				4, 501, 652	1, 290, 326	6, 522, 114
1923	6, 000				5, 035, 697	1, 341, 677	7, 725, 686
1924	9, 546				5, 294, 915	1, 745, 313	8, 002, 266
1925	14, 639				4, 459, 937	1, 719, 282	7, 775, 333
1926	11, 037				6, 652, 882	2, 065, 190	9, 572, 081
1927	13, 285				3, 572, 128	1, 357, 697	6, 443, 810
1928	4, 237				6, 083, 903	2, 035, 629	8, 944, 780
Total	209, 968	100, 572	9, 500	1, 419, 534	117, 402, 384	40, 099, 841	216, 607, 292

CANNING INDUSTRY, BY SPECIES AND WATERS

The tables which follow show separately, by waters and as far as possible by species, the salmon canned on the Pacific coast from the beginning of the industry until 1928. It is only within recent years that the published statistics have shown the pack of the different species separately. In the early years of canning the chinook, or quinnat, salmon was used exclusively, the other species not being utilized until the chinook had begun to decrease in abundance, or a demand had arisen for a cheaper product. There is a very great difference in the selling value of the highest and lowest grades, and it is necessary to have complete statistical data now in order intelligently to comprehend the trend of the industry. While every effort has been made to make these tables complete, there are, unfortunately, some gaps which it was found impossible to fill. Such ellipses indicate that either the canneries did not operate or that no data were available for such periods.

Although there are only five species of salmon found on the Pacific coast, each bears several common names which are in general use in one or more of the many fishing districts. Trade names of each species as known in each district follow:

Districts	1	2	3	4	5
Alaska	Red	King	Coho Medium Red. Silver.	Pink	Chum.
British Columbia	Sockeye	Spring	Coho	Humpback	Keta.
Puget Sound	do	Tyee Spring	do	do	Chum.
Columbia River	Blueback	Chinook	Silverside	(None packed)	Do.
Outside rivers	Quinault	Quinnat	do	do	Do.

Pack of canned salmon on Puget Sound in specified years

Year	Canneries operated	Chinook		Sockeye		Medium red or silver	
		Cases	Value	Cases	Value	Cases	Value
1877	1					5,000	
1878	1					238	
1879	1					1,300	$5,690
1880	1						
1881	1						
1882	1						
1883	1						
1884	1						
1888	4						
1889	2	240	$1,200			7,480	37,400
1890	1	1,000	5,000			3,000	15,000
1891	2	382	2,101	5,538	$24,921	5,869	19,308
1892	2	86	473	2,954	11,816	7,206	24,500
1893	3	1,200	6,480	47,852	103,371	11,812	59,000
1894	3			41,781	188,014	22,418	89,672
1895	7	1,542	7,325	65,143	273,108	50,865	154,218
1896	11	13,495	67,475	72,979	350,299	82,640	264,448
1897	12	9,500	39,045	312,048	1,248,192	91,900	282,133
1898	18	11,200	50,624	252,000	1,058,400	98,600	335,240
1899	19	24,364	103,180	499,646	2,368,334	111,387	418,176
1900	19	22,350	134,100	229,800	1,149,000	128,200	512,800
1901				1,220,000			
1902	21	30,049	150,245	372,301	2,047,655	85,817	429,085
1903	22	14,500	72,500	167,211	1,003,260	103,450	413,800
1904	13	14,441	69,352	109,264	653,871	118,127	447,851
1905	24	1,804	9,922	825,453	4,952,718	79,335	337,174
1906	16	8,139	48,834	178,748	1,251,236	94,497	472,485
1907	14	1,814	16,326	93,122	698,416	119,472	476,288
1908	11	95,210	666,470	170,951	1,196,657	128,922	644,922
1909	24	13,019	72,604	1,097,904	6,183,300	143,133	630,446
1910	15	10,064	60,324	248,014	1,673,095	162,755	895,153
1911	21	21,823	172,582	127,769	1,168,145	256,123	1,711,178
1912	21	20,252	101,706	184,680	1,660,173	149,727	761,200
1913	32	1,234	5,247	1,673,099	10,871,178	61,019	235,372
1914	22	27,140	179,532	339,787	2,751,832	158,933	715,995
1915	40	28,466	145,555	64,584	676,769	180,783	902,335
1916	32	45,072	270,432	90,866	817,790	208,967	1,044,835
1917	45	70,918	638,262	454,336	4,543,360	115,860	926,880
1918	33	62,821	565,385	52,587	736,225	235,795	2,004,258
1919	39	71,190	640,710	67,087	764,792	201,697	1,815,269
1920	19	27,482	274,820	62,751	1,211,094	25,321	164,587
1921	32	25,662	205,376	95,667	1,599,529	65,303	375,928
1922	21	21,911	214,910	50,235	850,416	115,405	674,928
1923	18	16,103	147,594	50,003	817,882	120,908	730,214
1924	12	16,319	208,718	70,749	1,072,083	84,850	660,411
1925	23	29,983	310,480	104,973	1,604,501	172,007	1,615,538
1926	14	27,780	305,930	44,568	720,786	120,950	1,020,429
1927	22	41,716	587,258	97,594	2,115,410	135,802	1,358,020
1928	14	23,153	291,493	60,081	1,207,981	89,923	777,472

Pack of canned salmon on Puget Sound in specified years—Continued

Year	Canneries operated	Chum		Pink		Steelhead		Total	
		Cases	Value	Cases	Value	Cases	Value	Cases	Value
1877	1			500				5,500	
1878	1							238	
1879	1							1,300	$5,690
1880	1							5,100	
1881	1							8,500	
1882	1							7,900	
1883	1							1,500	
1884	1							5,500	
1885								12,000	
1886								17,000	
1887								22,000	
1888	4							21,975	126,356
1889	2	1,145	$3,435	2,809	$7,584			11,674	49,619
1890	1	4,000	12,000					8,000	32,000
1891	2	3,093	10,825	5,647	15,246			20,529	72,461
1892	2	16,180	56,630					26,426	93,419
1893	3	11,380	31,295	17,530	47,331			89,774	247,537
1894	3	22,152	60,918	9,049	24,432			95,400	363,036
1895	7	38,785	94,741	23,633	62,556			179,968	591,948
1896	11	26,550	73,013					195,664	755,235
1897	12	23,310	64,103	57,268	171,804			494,026	1,805,277
1898	18	38,400	105,600					400,200	1,549,864
1899	19	31,481	86,427	252,733	734,241			919,611	3,710,358
1900	19	89,100	245,025					469,450	1,940,925
1901								1,380,590	
1902	21	93,492	467,460					581,659	3,094,445
1903	22	12,001	30,002	181,326	407,984			478,488	1,927,546
1904	13	49,656	124,254					291,488	1,295,328
1905	24	41,057	102,643	70,992	212,976			1,018,641	5,615,433
1906	16	149,218	708,781					430,602	2,481,336
1907	14	50,249	150,847	433,423	1,300,269			698,080	2,642,146
1908	11	47,007	142,821	6,075	18,225			448,765	2,669,095
1909	24	53,688	128,916	370,993	902,342			1,678,737	7,917,608
1910	15	146,942	514,297	108	388			567,883	3,143,256
1911	21	98,321	391,123	1,046,992	4,302,344			1,551,028	7,745,372
1912	21	60,760	154,193	700	2,185			416,119	2,679,457
1913	32	56,225	124,970	791,886	2,092,401			2,583,463	13,329,168
1914	22	290,477	903,675	1,017	4,615			817,354	4,555,649
1915	40	411,724	1,155,474	583,649	1,795,285			1,269,206	4,675,418
1916	32	564,194	2,031,098	143,804	575,216	14	$84	[1] 1,052,917	4,739,455
1917	45	218,977	1,270,067	1,130,163	6,780,978	4	36	1,990,258	14,159,583
1918	33	264,922	1,669,009	6,607	42,946			622,732	5,017,823
1919	39	529,967	3,179,802	437,731	3,392,411	62	620	1,307,734	9,793,604
1920	19	47,831	179,366	4,921	23,621	28	168	168,334	1,853,656
1921	32	27,315	98,485	375,900	1,394,494			589,847	3,673,812
1922	21	66,746	297,874	2,985	18,645			257,282	2,056,773
1923	18	100,652	477,283	469,869	2,310,681	29	174	757,564	4,483,828
1924	12	143,074	663,426	6,699	35,359	130	729	321,821	2,640,726
1925	23	42,715	139,911	557,086	2,893,984	229	1,786	906,993	6,566,200
1926	14	112,201	550,405	2,128	11,901	63	719	307,690	2,610,170
1927	22	38,129	225,654	578,923	3,669,941	80	1,056	892,244	7,957,339
1928	14	146,356	833,114	5,597	41,091	266	2,873	325,376	3,154,024

[1] The totals include large quantities of salmon brought to the sound canneries from other waters, principally in British Columbia, and packed here, these when prepared for market comprising approximately 141,917 cases of humpbacks or pinks, valued at $566,952; 136,316 cases of chums, valued at $538,937, and 53,135 cases of silvers, valued at $87,185; a grand total of 331,368 cases and $1,193,074.

Pack of canned salmon on Soleduck River, Wash., in specified years [1]

Year	Canneries operated	Chinook		Sockeye		Silverside	
		Cases	Value	Cases	Value	Cases	Value
1912	1	414	$2,484	15	$156	940	$4,324
1913	1	206	1,442			1,040	3,536
1914	1	237	1,185			1,439	5,574
1915	1	388	1,940			1,320	6,072

Year	Canneries operated	Pink [2]		Chum		Total	
		Cases	Value	Cases	Value	Cases	Value
1912	1	103	$268	76	$182	1,548	$7,414
1913	1			28	61	1,27[illegible]	5,039
1914	1	189	567	103	291	1,968	7,617
1915	1	826	2,478	192	538	2,726	11,028

[1] None packed since 1915. [2] These are virtually all light-colored chinooks.

Pack of canned salmon on Hoh River, Wash., in specified years [1]

Year	Canneries operated	Chinook		Silverside		Chum		Total	
		Cases	Value	Cases	Value	Cases	Value	Cases	Value
1917	1	372	$3,348	204	$1,665	110	$715	686	$5,728
1918	1	60	540	294	2,499	17	108	371	3,147
1919	1	18	216	233	2,796	332	2,125	583	5,137
1920	1	524	6,288	370	2,627	27	85	921	9,000
1921	1	366	3,682					366	3,682

[1] None packed since 1921.

Pack of canned salmon on Queets River, Wash., in specified years [1]

Year	Canneries operated	Chinook		Sockeye		Silverside	
		Cases	Value	Cases	Value	Cases	Value
1912	1	750	$4,500	200	$2,080	2,500	$11,500
1913	1	1,082	7,574	220	1,848	1,680	5,712
1914	1	1,175	5,875	200	2,134	1,800	6,966
1915	1			1,512	9,072		
1916	1	1,506	9,036			617	3,085
1917	1	713	6,417			1,196	9,759
1918	1	381	3,429	20	280	1,138	9,673
1919	1	450	5,400	100	1,600	1,025	12,300
1922	1			750	11,930		
1923	1	100	406	463	5,389	976	4,821
1924	1	127	814	257	4,166	1,314	8,541
1925	1	1,745	11,185	338	5,479	765	4,972
1926	1	592	3,242	146	2,380	1,311	9,832
1927	1	1,420	11,360	275	5,500		

Year	Canneries operated	Chum		Steelhead		Total	
		Cases	Value	Cases	Value	Cases	Value
1912	1	1,000	$2,400			4,450	$20,480
1913	1	670	1,461	600	$3,300	4,252	19,895
1914	1	1,020	2,887	500	2,750	4,695	20,612
1915	1					1,512	9,072
1916	1	415	1,245			2,538	13,366
1917	1	47	306	129	1,161	2,085	17,643
1918	1			[2] 87	870	1,626	14,252
1919	1	50	320			1,625	19,620
1922	1					750	11,930
1923	1	478	1,979	1,500	11,250	3,517	23,845
1924	1	675	2,902			2,373	16,423
1925	1	867	3,728			3,715	25,364
1926	1	579	2,695			2,570	18,149
1927	1					1,695	16,860

[1] No operations in 1920, 1921, and 1928. [2] 68 cases of these were smoked.

Pack of canned salmon on Quinault River, Wash., in specified years

Year	Canneries operated	Chinook		Sockeye		Silverside		Chum		Total	
		Cases	Value	Cases	Value	Cases	Value	Cases	Value	Cases	Value
1911 [1]	1	5,000	$35,000	2,031	$16,000	6,000	$42,000	5,400	$27,000	18,431	$120,000
1912	2			4,500	40,500	3,916	18,014	5,500	13,200	13,916	71,714
1913	1			492	4,133	7,106	24,160			7,598	28,293
1914	2	51	255	12,074	120,740	1,623	6,281	1,048	2,966	14,796	130,242
1915	2	1,144	6,864	22,972	239,989	1,388	6,807	1,993	5,580	27,497	259,240
1916	2	1,365	8,190	10,315	92,835	1,093	5,465	466	1,398	13,239	107,888
1917	2	309	2,781	4,608	55,296	2,609	21,289	1,821	11,836	[2] 10,553	98,438
1918	2	1,497	13,473	2,470	30,869	6,086	51,731	1,682	10,874	11,735	106,947
1919	2	165	2,063	1,144	18,304	775	9,300	650	4,160	2,734	33,827
1920	1			235	4,230					235	4,230
1921	2			2,590	41,440					2,590	41,440
1922	5	150	644	18,463	290,238	1,852	5,302	4,230	17,081	24,695	313,265
1923	2	612	2,485	9,991	116,295	1,081	5,340	6,756	27,970	18,440	152,090
1924	3			8,216	123,988					8,216	123,988
1925	3	450	2,885	2,975	48,225	475	3,087	190	817	4,090	55,014
1926	2			1,583	25,803					1,583	25,803
1927	4			4,985	99,700					4,985	99,700
1928	4			2,000	40,000					2,000	40,000

[1] Previous to this date the fish were transported to the Aberdeen and Hoquiam canneries and prepared there.
[2] Includes 1,206 cases of humpbacks, valued at $7,236.

Pack of canned salmon on Grays Harbor in specified years

Year	Canneries operated	Chinook		Silverside		Chum		Total	
		Cases	Value	Cases	Value	Cases	Value	Cases	Value
1878	1							5,420	$29,268
1879	1								
1885								8,200	
1886								18,700	
1888	4							37,000	212,750
1891	1			500	$1,500			500	1,500
1892	1	4,500	$15,390	9,000	30,780	3,000	$9,415	16,500	55,585
1893	1	4,500	22,500	12,000	48,000	5,500	14,850	22,000	85,350
1894	1	12,300	61,500	4,100	16,400	5,000	13,500	21,400	91,400
1895	1	56	202	8,876	28,403	2,517	6,922	11,449	35,527
1896	2	7,816	36,806	9,278	29,689	4,180	11,495	21,274	57,990
1897	1	3,100	11,741	8,300	23,481	1,900	5,000	13,300	40,222
1898	2	5,100	23,052	4,800	16,320	2,200	6,050	12,100	45,422
1899	1	5,000	21,250	15,740	59,025	3,500	8,750	24,240	89,025
1900	2	6,700	33,500	12,900	51,600	11,200	30,800	30,800	115,900
1901								41,500	
1902	1	4,000	20,000	10,000	45,000	17,500	70,000	31,500	135,000
1904	2	4,339	20,163	14,904	51,854	8,316	21,022	27,559	93,039
1905	2	2,050	9,225	13,000	52,000	7,000	18,200	22,050	79,425
1906	2	2,500	10,000	11,500	43,900	8,000	21,500	22,000	75,400
1907	1	1,000	7,000	9,500	47,500	3,500	11,500	14,000	66,000
1908	1	1,000	7,000	9,500	47,500	3,500	11,500	14,000	66,000
1909	1	5,721	20,819	9,019	38,146	5,047	11,608	[1] 21,436	79,624
1910	3	15,495	90,718	21,768	108,840	13,867	48,534	[2] 55,480	272,017
1911	4	15,773	110,411	28,991	202,937	[3] 31,177	155,885	75,941	469,233
1912	5	9,060	54,360	26,162	120,345	12,065	28,956	47,287	203,661
1913	4	1,253	8,771	5,723	19,458	12,919	28,163	19,895	56,392
1914	4	11,899	59,495	9,156	35,434	11,379	32,203	32,434	127,132
1915	4	4,219	20,089	14,036	61,707	22,737	63,678	40,992	145,474
1916	5	12,400	74,403	11,580	57,898	32,560	117,744	[4] 60,336	265,229
1917	9	12,124	109,116	9,589	51,246	10,910	70,915	[5] 42,696	291,715
1918	6	8,731	99,912	21,994	201,705	5,247	37,915	35,972	339,532
1919	6	4,370	54,626	12,214	146,608	28,712	183,757	45,296	384,991
1920	1	337	4,044	35	249			372	4,293
1921	2	942	9,476	2,834	13,079	2,746	9,270	5,544	31,825
1922	3	57	244	4,052	18,558	10,077	40,106	14,186	58,908
1923	4	3,076	12,489	3,085	15,240	20,828	86,228	26,989	113,957
1924	4	35	215	3,513	19,813	26,435	111,820	29,991	131,848
1925	4	992	6,359	6,411	41,671	22,281	95,808	29,684	143,838
1926	3			556	3,047	7,978	37,098	8,534	40,145
1927	3	338	2,076	324	1,944	12,177	73,136	12,839	77,156
1928	4			77	462	15,876	79,380	15,953	79,842

[1] Includes 1,649 cases, valued at $9,051, packed with sockeyes brought from Puget Sound.
[2] Includes 4,350 cases of "quinault," or sockeye, salmon, valued at $23,925.
[3] Includes 6,730 cases of humpbacks.
[4] Includes 3,796 cases of humpbacks, valued at $15,184.
[5] Includes 10,073 cases of humpbacks, valued at $60,438.

Pack of canned salmon on Willapa Harbor in specified years

Year	Canneries operated	Chinook		Silverside		Chum		Humpback		Total	
		Cases	Value	Cases	Value	Cases	Value	Cases	Value	Cases	Value
1886										13,600	
1887	4										
1888	3									22,500	$129,375
1891	1			8,000	$24,000					8,000	24,000
1892	1	3,000	$10,260	9,000	30,780	2,500	$7,745			14,500	48,785
1893	1	1,700	9,180	7,895	31,580	6,600	18,150			16,195	58,910
1894	1	2,700	14,580	5,600	22,400	6,800	18,700			15,100	55,680
1895	2	4,636	23,180	13,047	41,150	4,917	13,222			22,600	77,552
1896	2	4,551	22,755	11,940	38,208	8,450	21,238			24,941	82,201
1897	1	8,100	33,291	14,600	44,822	6,900	18,975			29,600	97,088
1898	2	5,865	26,510	9,809	33,351	5,746	15,802			21,420	75,663
1899	3	5,650	25,425	10,675	40,031	4,989	13,720			21,314	79,176
1900	3	6,700	33,500	12,400	49,600	7,200	19,800			26,300	102,900
1901										34,000	
1902	2	5,836	29,186	9,128	41,076	24,528	97,112			39,492	167,368
1903	1	2,300	13,800	2,390	10,755	1,200	3,300			5,890	27,855
1904	2	3,000	12,000	7,400	28,440	16,000	38,700			26,400	79,140
1905	2	4,650	20,925	4,300	17,200	6,000	15,000			14,950	53,125
1906	2	4,000	16,000	5,340	21,360	5,100	13,260			14,440	50,620
1907	2	3,530	15,354	9,228	36,682	624	2,496			13,382	54,532
1908	2	4,017	20,585	5,923	23,692	10,517	36,809			20,457	81,086
1909	1	1,455	5,869	4,822	17,359	5,747	13,163			12,024	36,391
1910	1	2,923	15,077	5,096	25,480	3,489	22,711			11,508	63,268
1911	2	5,717	40,019	9,298	65,086	10,482	52,410			25,497	157,515
1912	3	6,123	36,738	8,030	36,938	9,533	22,879	4,462	$11,601	28,148	108,156
1913	2	67	469	3,111	10,577	8,872	19,368			12,050	30,414
1914	3	2,924	14,431	7,179	27,749	6,734	19,077			16,837	61,256
1915	2	3,148	19,380	4,008	18,437	5,686	15,921			12,842	53,738
1916	2	5,115	30,690	3,365	16,825	10,073	36,262			18,553	83,777
1917	2	1,720	18,920	2,143	19,287	4,516	30,708			8,379	68,915
1918	2	921	10,131	5,249	50,390	2,657	18,599			8,827	79,120
1919	2	1,152	12,672	1,491	14,910	9,301	65,107	1,688	8,440	13,632	101,129
1920		62	837							62	837
1921	1	623	4,673	1,683	6,732	2,719	9,788	141	536	5,166	21,729
1922	3	1,168	6,168	1,549	10,260	2,289	8,579	56	224	5,062	25,231
1923 [1]	1	375	3,525	45	225	6,402	36,142			7,466	46,203
1924	4	168	1,275	602	4,455	21,959	70,582	1,104	5,400	23,833	81,712
1925	3	13,500	67,500	10	72	19,561	58,740			33,071	126,312
1926	4	1,491	13,517	1,400	8,240	8,205	34,320	275	1,375	11,371	57,452
1927	5	2,668	21,342	1,731	12,133	17,394	80,682			21,793	114,157
1928	4	502	4,518	338	2,028	8,647	43,235			9,487	49,781

[1] In 1923 there were 644 cases of steelheads packed, valued at $6,311.

Pack of canned salmon on the Columbia River from the inception of the industry to 1928

Year	Canneries operated	Chinook		Blueback		Silverside	
		Cases	Value	Cases	Value	Cases	Value
1866	1	4,000	$64,000				
1867	1	18,000	288,000				
1868	2	28,000	392,000				
1869		100,000	1,350,000				
1870		150,000	1,800,000				
1871		200,000	2,100,000				
1872		250,000	2,325,000				
1873		250,000	2,250,000				
1874	13	350,000	2,625,000				
1875	13	375,000	2,250,000				
1876	17	450,000	2,475,000				
1877		380,000	2,052,000				
1878	30	460,000	2,300,000				
1879	30	480,000	2,640,000				
1880	35	530,000	2,650,000				
1881	35	550,000	2,475,000				
1882		541,300	2,600,000				
1883		629,400	3,147,000				
1884		620,000	2,915,000				
1885		553,800	2,500,000				
1886	39	448,500	2,135,000				
1887		356,000	2,124,000				
1888	28	372,477	2,327,981				
1889	21	266,697	1,600,182	17,797	$101,051		
1890	21	335,604	1,946,087	57,345	290,069		
1891	22	353,907	2,038,566	15,482	284,242		
1892	24	344,267	1,996,388	66,547	372,909	4,176	$20,880
1893	24	288,773	1,559,374	30,459	152,295	29,107	116,428
1894	24	351,106	1,895,976	43,814	224,430	42,758	171,032
1895	24	444,909	2,428,658	18,015	86,523	99,601	329,683
1896	24	370,943	1,840,511	16,983	81,518	44,108	141,145
1897	22	432,753	1,804,221	12,972	51,888	60,850	197,762
1898	23	329,566	1,490,394	66,670	300,015	65,431	222,465
1899	17	255,824	1,458,175	23,969	134,723	29,608	112,055
1900	16	262,392	1,821,258	13,162	92,184	44,925	202,163
1902	14	270,580	1,428,743	17,037	86,465	10,532	44,732
1903	16	301,762	1,610,614	8,383	42,867	12,181	49,869
1904	20	320,378	1,944,690	12,911	78,048	31,254	118,357
1905	19	327,106	1,962,636	7,768	46,608	26,826	114,011
1906	19	311,334	1,868,007	7,816	54,712	41,446	124,338
1907	19	258,433		5,504		31,757	
1908	14	210,096		8,581		31,432	
1909	15	162,131	1,203,546	[1] 27,908	214,561	42,178	185,070
1910	15	244,285	1,882,137	6,234	34,287	68,922	363,688
1911	15	405,862	2,204,185	5,988	47,904	79,416	549,478
1912	15	220,317	1,988,526	8,210	85,384	31,842	177,248
1913	15	192,116	1,664,670	11,152	93,677	40,969	175,412
1914	17	289,464	2,573,502	35,311	376,924	69,769	380,666
1915	19	406,486	3,694,361	5,459	56,707	33,336	173,234
1916	20	395,166	3,572,203	3,790	27,288	52,084	335,114
1917	20	403,637	5,023,529	7,968	111,552	64,299	700,680
1918	20	400,952	5,222,983	37,833	605,328	98,145	1,072,843
1919	21	392,125	5,031,207	7,268	73,116	90,728	1,052,767
1920	22	420,467	6,286,403	2,617	41,872	27,024	189,168
1921	21	267,852	3,643,282	6,045	89,820	34,381	239,613
1922	23	237,230	3,257,244	30,743	442,466	90,437	605,942
1923	23	289,586	4,638,956	38,309	518,724	101,554	630,543
1924	22	293,716	3,991,588	7,366	118,587	112,308	742,445
1925	21	350,809	4,869,950	5,650	103,182	113,544	1,196,749
1926	21	295,302	4,140,271	21,736	388,621	97,142	981,217
1927	22	339,446	5,559,222	6,887	147,378	74,879	585,816
1928	24	251,404	4,355,218	4,818	100,131	49,136	478,355

[1] Of these, 2,846 cases, valued at $23,203, were packed with sockeyes brought from Puget Sound.

Pack of canned salmon on the Columbia River from the inception of the industry to 1928—Continued

Year	Canneries operated	Humpback		Chum		Steelhead trout		Total	
		Cases	Value	Cases	Value	Cases	Value	Cases	Value
1866	1							4,000	$64,000
1867	1							18,000	288,000
1868	2							28,000	392,000
1869								100,000	1,350,000
1870								150,000	1,800,000
1871								200,000	2,100,000
1872								250,000	2,325,000
1873								250,000	2,250,000
1874	13							350,000	2,625,000
1875	13							375,000	2,250,000
1876								450,000	2,475,000
1877								380,000	2,052,000
1878	30							460,000	2,300,000
1879	30							480,000	2,640,000
1880	29							530,000	2,650,000
1881	35							550,000	2,475,000
1882								541,300	2,600,000
1883								629,400	3,147,000
1884								620,000	2,915,000
1885								553,800	2,500,000
1886	39							448,500	2,135,000
1887								356,000	2,124,000
1888	28							372,477	2,327,981
1889	21					25,391	$108,587	309,885	1,809,820
1890	21					42,825	171,300	435,774	2,407,456
1891	22					29,564	118,156	398,953	2,440,964
1892	24					72,348	288,892	487,338	2,679,069
1893	24			2,311	$6,933	65,226	260,904	415,876	2,095,934
1894	24					52,422	209,688	490,100	2,501,126
1895	24			22,493	62,591	49,678	203,542	634,696	3,110,997
1896	24					49,663	198,652	481,697	2,261,826
1897	22					46,146	165,440	552,721	2,219,311
1898	23					26,277	60,352	487,944	2,073,226
1899	17			11,379	33,836	11,994	39,186	332,774	1,777,975
1900	16			17,696	63,706	20,597	102,985	358,772	2,282,296
1901								390,183	1,942,660
1902	14			10,401	41,604	8,593	42,965	317,143	1,644,509
1903	16			10,000	37,500	7,251	36,255	339,577	1,777,105
1904	20			20,693	52,691	9,868	48,892	395,104	2,242,678
1905	19			25,751	65,206	9,822	49,110	397,273	2,237,571
1906	19			27,802	69,505	6,500	32,500	394,898	2,149,062
1907	19			22,556		5,921		324,171	1,763,490
1908	14			16,884		10,726		277,719	1,380,708
1909	15	[2] 55	$132	24,542	57,115	17,382	99,796	274,196	1,760,220
1910	15			66,538	232,883	5,436	31,203	391,415	2,544,198
1911	15			53,471	203,198	8,594	47,399	553,331	3,052,164
1912	15			18,699	46,590	6,958	22,108	286,026	2,319,856
1913	15			13,303	29,486	8,939	49,142	266,479	2,012,387
1914	17			49,285	305,541	10,792	59,356	454,621	3,695,989
1915	19			86,530	251,632	26,723	129,358	558,534	4,305,292
1916	20	56	224	77,766	307,483	18,999	118,987	547,861	4,361,299
1917	20			53,659	386,596	23,783	292,583	553,346	6,514,940
1918	20			29,846	215,669	24,605	350,071	591,381	7,466,894
1919	21			75,493	441,989	14,414	144,140	580,028	6,743,219
1920	22			18,792	60,134	12,645	151,740	481,545	6,729,317
1921	21			3,700	10,174	10,142	110,618	322,120	4,093,507
1922	23			8,844	47,640	24,920	223,566	392,174	4,576,858
1923	23			25,508	110,638	25,968	269,765	480,925	6,168,626
1924	22	593	2,709	57,748	257,502	29,734	273,581	501,465	5,386,412
1925	21	84	278	55,812	246,010	14,637	205,204	540,536	6,621,373
1926	21			32,853	141,926	32,690	352,744	479,723	6,004,779
1927	22			68,449	425,240	30,148	311,070	519,809	7,028,726
1928	24			124,953	747,619	16,339	222,139	446,650	5,903,467

[2] Packed with humpbacks brought from Puget Sound.

Pack of canned salmon on the Columbia River, by States, 1917–1928

States and species	1917		1918		1919		1920	
	Cases	Value	Cases	Value	Cases	Value	Cases	Value
Washington:								
Blueback	2, 801	$33, 612	19, 450	$245, 070	2, 329	$18, 632	1, 297	$20, 752
Chinook	146, 140	1, 753, 680	145, 511	1, 715, 874	[1] 130, 185	1, 671, 007	[2] 140, 319	2, 098, 190
Chum	14, 539	93, 050	12, 173	85, 211	39, 279	235, 674	4, 911	15, 715
Silverside	15, 989	183, 874	35, 746	343, 162	34, 927	349, 270	7, 398	51, 786
Steelhead	6, 053	66, 583	8, 699	104, 388	7, 148	71, 480	4, 977	59, 724
Total	185, 522	2, 130, 799	221, 579	2, 493, 705	213, 868	2, 346, 063	158, 902	2, 246, 167
Oregon:								
Blueback	5, 167	77, 940	18, 383	360, 258	4, 939	54, 484	1, 320	21, 120
Chinook	257, 497	3, 269, 849	255, 441	3, 507, 109	261, 940	3, 360, 200	280, 148	4, 188, 213
Chum	39, 120	293, 546	17, 673	130, 458	36, 214	206, 315	13, 881	44, 419
Silverside	48, 310	516, 806	62, 399	729, 681	55, 801	703, 497	19, 626	137, 382
Steelhead	17, 730	225, 955	15, 906	245, 683	7, 266	72, 660	7, 668	92, 016
Total	367, 824	4, 384, 096	369, 802	4, 973, 189	366, 160	4, 397, 156	322, 643	4, 483, 150
Grand total	553, 346	6, 514, 895	591, 381	7, 466, 894	580, 028	6, 743, 219	481, 545	6, 729, 317

States and species	1921		1922		1923		1924	
	Cases	Value	Cases	Value	Cases	Value	Cases	Value
Washington:								
Blueback	2, 674	$39, 727	17, 568	$252, 878	19, 084	$258, 417	2, 591	$41, 709
Chinook	104, 349	1, 419, 641	99, 096	1, 360, 664	94, 821	1, 518, 821	110, 872	1, 506, 738
Chum	641	1, 762	7, 609	40, 983	16, 401	71, 114	13, 899	61, 935
Humpback							593	2, 709
Silverside	8, 454	58, 902	28, 580	191, 500	27, 918	173, 263	22, 965	151, 888
Steelhead	8, 955	97, 668	8, 047	72, 215	13, 103	136, 098	9, 617	88, 505
Total	125, 073	1, 617, 700	160, 900	1, 918, 240	171, 327	2, 157, 713	160, 537	1, 853, 484
Oregon:								
Blueback	3, 371	50, 093	13, 175	189, 588	19, 225	260, 307	4, 775	76, 878
Chinook	163, 503	2, 223, 641	138, 134	1, 896, 580	194, 765	3, 120, 135	182, 844	2, 484, 850
Chum	3, 059	8, 412	1, 235	6, 657	9, 107	39, 524	43, 849	195, 567
Silverside	25, 927	180, 711	61, 857	414, 442	73, 636	457, 280	89, 343	590, 557
Steelhead	1, 187	12, 950	16, 873	151, 351	12, 865	133, 667	20, 117	185, 076
Total	197, 047	2, 475, 807	231, 274	2, 658, 618	309, 598	4, 010, 913	340, 928	3, 532, 928
Grand total	322, 120	4, 093, 507	392, 174	4, 576, 858	480, 925	6, 168, 626	501, 465	5, 386, 412

States and species	1925		1926		1927		1928	
	Cases	Value	Cases	Value	Cases	Value	Cases	Value
Washington:								
Blueback	2, 900	$52, 967	9, 392	$167, 910	3, 170	$67, 521	3, 307	$66, 140
Chinook	170, 181	2, 362, 833	105, 791	1, 483, 327	141, 377	2, 588, 187	143, 841	2, 445, 297
Chum	30, 228	133, 185	6, 738	29, 109	15, 409	95, 536	51, 593	309, 558
Humpback	84	278						
Silverside	20, 732	218, 511	17, 103	172, 823	34, 619	269, 228	23, 242	217, 772
Steelhead	3, 396	47, 605	7, 148	77, 146	6, 021	62, 016	9, 988	134, 838
Total	227, 521	2, 815, 379	146, 172	1, 930, 315	200, 596	3, 082, 488	231, 971	3, 173, 605
Oregon:								
Blueback	2, 750	50, 215	12, 344	220, 711	3, 717	79, 857	1, 511	33, 991
Chinook	180, 628	2, 507, 117	189, 511	2, 656, 944	198, 069	2, 971, 035	107, 563	1, 909, 921
Chum	25, 584	112, 825	26, 115	112, 817	53, 040	329, 704	73, 360	438, 061
Silverside	92, 812	978, 238	80, 039	808, 394	40, 260	316, 588	25, 894	260, 583
Steelhead	11, 241	157, 599	25, 542	275, 598	24, 127	249, 054	6, 351	87, 301
Total	313, 015	3, 805, 994	333, 551	4, 074, 464	319, 213	3, 946, 238	214, 679	2, 729, 857
Grand total	540, 536	6, 621, 373	479, 723	6, 004, 779	519, 809	7, 028, 726	446, 650	5, 903, 462

[1] Includes 106,328 cases spring chinooks, valued at $1,382,264; 21,740 cases fall chinooks, valued at $273,924; and 2,117 cases light-colored chinooks, valued at $14,819.

[2] Includes 138,258 cases spring chinooks, valued at $2,073,870; and 2,061 cases fall chinooks, valued at $24,310.

Pack of canned salmon in specified years

NEHALEM RIVER, OREG.

Year	Canneries operated	Chinook		Silverside		Chum		Total	
		Cases	Value	Cases	Value	Cases	Value	Cases	Value
1887	1							5,000	$30,000
1889								6,000	32,000
1890								9,000	45,500
1891	1							3,500	14,000
1892	1			10,000	$40,000			10,000	40,000
1893	1	1,692	$6,768	5,031	20,124			6,723	26,892
1894	1	1,627	6,508	4,866	19,464			6,493	25,972
1895	1	1,752	7,008	5,152	16,486			6,904	23,494
1896	1	2,828	8,484	5,218	15,654			8,046	24,138
1897	2	3,384	10,152	8,366	25,098			11,750	35,250
1898	1	3,808	9,891	5,700	19,380			9,508	29,271
1899	1	1,384	5,536	7,405	26,658	1,288	$3,864	10,077	36,058
1900	1								
1901	1	268	1,139	3,273	13,092	2,669	7,206	6,210	21,437
1902	1	271	1,431	3,169	13,468	2,570	10,280	6,010	25,179
1903	1	686	3,670	4,615	19,614			5,301	22,284
1904	1	500	2,500	5,000	20,000	6,000	12,000	11,500	34,500
1905	1	2,700	16,200	2,900	12,325	6,000	15,000	11,600	43,525
1906	1	3,987	23,922	4,976	14,928	2,057	5,143	11,020	42,993
1907	1	4,000	28,000	6,600	19,800	2,000	6,000	12,600	53,800
1908	1	5,000	35,000	6,100	18,300	2,016	6,048	13,116	59,348
1909	1	1,985	10,542	4,554	20,253	909	2,091	7,448	32,886
1910	1	3,500	24,500	5,400	29,700	1,500	4,500	10,400	58,700
1911	2	5,821	46,568	14,878	81,829	3,439	13,048	24,138	141,445
1912	2			13,331	73,321	1,571	3,927	14,902	77,248
1913	1	300	1,500	764	3,056	5	11	1,069	4,567
1914	2	4,841	33,887	11,800	63,720	1,668	4,150	18,309	101,777
1915	2	400	2,400	5,400	24,840	2,260	6,328	8,060	33,568
1916	2	2,700	21,656	3,474	17,370	833	2,499	7,007	41,525
1917	2	783	7,047	851	6,808	472	3,304	2,106	17,159
1918	2	1,685	18,535	9,200	88,320	519	3,633	11,404	110,488
1919	2	500	6,250	8,124	97,488	1,183	7,571	9,807	111,309
1922 [1]	1			2,000	9,160			2,000	9,160

TILLAMOOK BAY, OREG. [2]

1884								4,500	
1885								9,800	
1886	2							37,000	
1887	2							21,000	$115,500
1888	2							14,633	84,140
1889								9,500	52,250
1890								14,009	79,049
1891	1								
1892	1			18,000	$72,000			18,000	72,000
1893	1	497	$1,988	4,000	16,000	6,919	$17,297	11,416	35,285
1894	1	700	2,800	7,763	31,052	700	1,750	9,163	35,602
1895	1			6,514	20,845	7,001	19,253	13,515	40,098
1896	1	2,200	6,600	4,860	14,580			7,060	21,180
1897	1	2,000	6,000	9,000	27,000			11,000	33,000
1898	1	5,000	13,000	10,342	35,162			15,342	48,162
1899	1	2,180	8,720	3,889	14,036	5,121	15,363	11,190	38,119
1900	1								
1901	1	848	4,240	2,133	9,598	3,901	10,728	6,882	24,566
1902	1	215	1,135	2,287	9,720	4,093	16,372	6,595	27,227
1903	1			2,727	11,590	2,620	10,480	5,347	22,070
1904	1			4,400	17,600	6,500	13,000	10,900	30,600
1905	1	1,100	6,600	1,700	7,650	8,800	22,000	11,600	36,250
1906	1	1,870	11,220	2,364	7,092	1,270	3,175	5,504	21,487
1907	1	2,000	14,000	3,410	10,230	2,314	6,942	7,724	31,172
1908	1	2,300	16,100	6,000	21,000	4,000	12,000	12,300	49,100
1909	1	2,615	15,663	5,029	21,809	3,712	8,538	11,356	46,010
1910	1	2,900	20,300	4,500	24,750	2,000	6,000	9,400	51,050
1911	2	8,433	67,464	12,663	69,647	5,277	20,053	26,373	157,164
1912	2	3,811	26,677	6,418	32,090	4,550	11,375	14,779	70,142
1913	1	2,600	15,600	1,000	4,000	1,000	2,200	4,600	21,800
1914	2	4,734	33,138	4,131	22,307	6,707	16,867	15,572	72,312
1915	3	5,675	34,300	4,549	20,925	9,099	25,477	19,323	70,702
1916	3	9,465	75,720	4,333	21,665	7,530	22,590	21,328	119,975
1917	3	8,822	79,398	5,522	44,176	6,941	48,587	21,285	172,161
1918	1	107	1,177	3,461	33,226	1,567	10,969	5,135	45,372
1919	2	1,500	18,750	7,150	85,800	4,350	27,840	13,000	132,390
1922	1					2,248	8,947	2,248	8,947
1923	2					14,000	57,960	14,000	57,960
1924	2	155	952	2,290	12,916	14,072	59,525	16,517	73,393
1925	3	1,568	10,051	2,562	16,653	13,614	58,540	17,744	85,244
1926	1					4,838	22,497	4,838	22,497
1927	2					13,970	69,850	13,970	69,850
1928	1					5,500	27,500	5,500	27,500

[1] None packed in 1920 and 1921 nor since 1922.
[2] None packed in 1920 and 1921.

Pack of canned salmon in specified years—Continued

NESTUGGA RIVER, OREG.[3]

Year	Canneries operated	Chinook		Silverside		Chum		Total	
		Cases	Value	Cases	Value	Cases	Value	Cases	Value
1887	1							4, 300	$23, 650
1888	1							5, 000	28, 750
1889								6, 700	36, 850
1891	1								
1899	1	1, 109	$4, 436	3, 034	$10, 922	513	$1, 539	4, 656	16, 897
1900	1								
1901	1	279	1, 116	3, 553	13, 323	396	1, 089	4, 228	15, 528
1905	1	3, 000	18, 000	1, 000	4, 250	400	1, 000	4, 400	23, 250
1906	1	2, 622	15, 732	2, 468	7, 404	165	413	5, 255	23, 549
1907	1	2, 100	14, 700	3, 540	10, 620	150	450	5, 790	25, 770
1908	1	2, 000	14, 000	3, 000	10, 500	100	300	5, 100	24, 800
1910	1	2, 000	14, 000	3, 300	18, 150	140	420	5, 440	32, 570
1911	1	3, 562	28, 496	7, 124	39, 182	641	2, 436	11, 327	70, 114
1912	1	3, 090	18, 540	6, 180	30, 900	708	1, 770	9, 978	51, 210
1913	1	126	756	243	972			369	1, 728
1914	1	3, 542	24, 794	5, 730	30, 942	265	662	9, 537	56, 308
1915	1	200	1, 300	3, 930	18, 078	800	2, 240	4, 930	21, 618
1916	1	2, 400	19, 200	4, 056	20, 280	200	600	6, 656	40, 800
1917	1	2, 000	18, 000	3, 800	30, 400	260	1, 820	6, 060	50, 220
1918	1	3, 000	33, 000	3, 206	30, 778	215	1, 505	6, 421	65, 283
1919	1	1, 900	23, 750	2, 400	28, 800	450	2, 880	4, 750	55, 430
1926	1	600	4, 200	550	3, 014			1, 150	7, 214

SILETZ RIVER, OREG.[4]

Year	Canneries operated	Chinook Cases	Chinook Value	Silverside Cases	Silverside Value	Chum Cases	Chum Value	Total Cases	Total Value
1896	1	2, 500	$7, 500	1, 900	$5, 700			4, 400	$13, 200
1897	1	3, 510	10, 530	5, 015	15, 045			8, 525	25, 575
1898	1	3, 200	8, 360	4, 330	14, 722			7, 530	23, 082
1899	1	2, 200	9, 900	2, 319	8, 696	200	$550	4, 719	19, 146
1900	1								
1901	1	876	4, 380	3, 740	16, 830	360	1, 260	4, 976	22, 470
1902	1	600	3, 168	1, 917	8, 147	500	2, 000	3, 017	13, 315
1904	1	1, 000	5, 000	3, 300	13, 200	1, 000	2, 000	5, 300	20, 200
1905	1	1, 500	9, 000	1, 700	7, 225	900	2, 250	4, 100	18, 475
1906	1	2, 635	15, 810	3, 192	9, 576	167	418	5, 994	25, 804
1907	1	2, 333	16, 331	4, 300	12, 900	200	600	6, 833	29, 831
1908	1	2, 100	14, 700	4, 700	16, 450	300	900	7, 100	32, 050
1910	1	2, 200	15, 400	4, 600	25, 300	250	750	7, 050	41, 450
1911	1	3, 584	28, 672	7, 164	39, 402	237	901	10, 985	68, 975
1912	1	3, 277	19, 662	6, 554	32, 770	283	707	10, 114	53, 139
1913	1	15	75	354	1, 416	17	37	386	1, 528
1914	1	3, 356	23, 492	6, 712	36, 245	196	490	10, 264	60, 227
1915	1	100	600	3, 000	13, 800	100	280	3, 200	14, 680
1916	1	1, 000	8, 000	3, 000	15, 000	210	630	4, 210	23, 630
1917	1	1, 800	16, 200	3, 400	28, 200	222	1, 554	5, 422	45, 954
1918	2	4, 304	47, 344	7, 789	74, 774	384	2, 688	12, 477	124, 806
1919	2	1, 393	17, 413	5, 892	70, 704	472	3, 021	7, 757	91, 138
1920	1	2, 002	24, 024	463	3, 292			2, 465	27, 316
1921	1	3, 136	31, 548	122	564			3, 258	32, 112
1922	1	1, 702	7, 285	5, 024	23, 010			6, 726	30, 295
1923	1	1, 000	4, 060	1, 400	6, 916			2, 400	10, 976
1924	1	1, 910	11, 727	2, 551	14, 388	437	1, 849	4, 898	27, 964
1925	1	203	1, 301	3, 036	19, 734	660	2, 838	3, 899	23, 873
1926	1	3, 028	21, 196	1, 650	9, 042			4, 678	30, 238
1927	1	2, 000	15, 000	4, 504	31, 528	181	905	6, 685	47, 433

[3] Cannery not operated from 1920 to 1925, inclusive, nor since 1926.
[4] Cannery not operated in 1928.

Pack of canned salmon in specified years—Continued

YAQUINA BAY AND RIVER, OREG.[5]

Year	Canneries operated	Chinook		Silverside		Chum		Total	
		Cases	Value	Cases	Value	Cases	Value	Cases	Value
1887	2								
1888	3							5,088	$29,256
1889								5,000	27,500
1891	1								
1896	1	1,714	$5,142	615	$1,845			2,329	6,987
1898	1	170	442	1,530	5,202			1,700	5,644
1899	2	316	1,422	3,234	12,127	1,300	$3,575	4,850	17,124
1900	1								
1901	1	96	480	2,848	12,816	549	1,647	3,493	14,943
1903	1			1,238	5,262	315	787	1,553	6,049
1904	1	50	200	2,600	8,840	450	1,080	3,100	10,120
1905	1	200	1,200	2,050	8,613	62	155	2,312	9,968
1906	1	500	3,000	3,100	9,300	60	150	3,660	12,450
1907	1	834	5,838	1,000	3,000	49	147	1,883	8,985
1908	1			4,000	14,000			4,000	14,000
1909	1			1,139	4,556	33	76	1,172	4,632
1910	1			2,669	13,345			2,669	13,345
1911	1			1,009	5,549	51	289	1,060	5,838

ALSEA RIVER AND BAY, OREG.[6]

Year	Canneries operated	Chinook Cases	Chinook Value	Silverside Cases	Silverside Value	Chum Cases	Chum Value	Total Cases	Total Value
1886	1								
1887	2							11,180	$64,285
1888	3							9,620	55,315
1889								10,000	55,000
1891	1								
1892	1			3,600	$14,400			3,600	14,400
1893	1	1,260	$6,300	3,240	12,960			4,500	19,260
1894	1	440	2,200	4,160	16,640			4,600	18,840
1895	1	1,700	6,375	3,280	11,808			4,980	18,183
1896	1	3,500	10,500	3,400	10,200			6,900	20,700
1897	1	1,800	5,400	3,200	9,600			5,000	15,000
1898	1	4,296	11,170	2,170	7,378			6,466	18,548
1899	1	2,150	9,138	5,010	19,038			7,160	28,176
1900	1								
1901	1	695	3,475	4,629	18,790	891	$3,118	6,215	25,383
1902	1	701	3,702	4,530	19,253	670	2,680	5,901	25,635
1903	1	1,031	5,516	4,242	18,029	44	88	5,317	23,633
1904	1	1,000	5,000	6,500	26,000	300	600	7,800	31,600
1905	1	2,500	15,000	1,800	7,650	700	1,750	5,000	24,400
1906	1	3,702	22,212	3,843	11,529			7,545	33,741
1907	1	800	5,600	5,100	15,300	350	1,050	6,250	21,950
1908	1	1,200	8,400	6,000	21,000	400	1,200	7,600	30,600
1909	1	1,119	6,714	5,486	24,027	80	184	6,685	30,925
1910	1	2,500	17,500	5,900	31,950	100	300	8,500	49,750
1911	2	4,161	33,288	9,329	51,309	688	2,614	14,178	87,211
1912	2	3,731	22,386	8,286	41,430	524	1,310	12,541	65,126
1913	2	1,607	8,035	4,304	17,216	160	352	6,071	25,603
1914	2	4,546	31,822	6,728	36,331	73	183	11,347	68,336
1915	2	1,668	10,763	6,966	32,044	178	498	8,812	43,305
1916	2	2,624	20,992	3,864	19,320	292	876	6,780	41,188
1917	2	2,727	24,543	6,621	52,968	418	2,926	9,766	80,437
1918	2	2,000	22,000	7,215	69,264	312	2,178	[7] 10,068	99,934
1919	2	2,512	31,400	2,607	31,200	535	3,718	5,654	66,318
1920	1	3,367	40,404	982	6,982			4,349	47,386
1923	1			2,458	12,143	279	1,155	2,737	13,298
1924	1	466	2,861	4,156	23,440	94	398	4,716	26,699
1925	1	1,411	9,045	950	6,175	136	585	2,497	15,805
1926	1	34	238	707	3,874			741	4,112

[5] Cannery not operated from 1912 to 1916, both years inclusive. In 1917 it was consolidated with Waldport cannery owned by same party. No canning since.
[6] None canned in 1920 and 1922 nor since 1926.
[7] Includes 541 cases of bluebacks, valued at $6,492.

Pack of canned salmon in specified years—Continued

SIUSLAW RIVER, OREG.

Year	Canneries operated	Chinook		Silverside		Chum		Total	
		Cases	Value	Cases	Value	Cases	Value	Cases	Value
1878	2							10,300	$55,620
1879	2								
1886	1							1,500	
1888	3							11,960	68,770
1889	1							12,000	66,000
1891	2								
1892	2			18,000	$72,000			18,000	72,000
1893	2	1,471	$7,355	11,830	47,320			13,301	54,675
1894	2	1,871	9,355	14,987	59,948			16,858	69,303
1895	2	1,637	6,139	10,465	35,274			12,102	41,413
1896	1	2,700	8,100	9,000	27,000			11,700	35,100
1897	1	1,100	3,300	3,900	11,700			5,000	15,000
1898	1	850	2,210	10,000	34,000			10,850	36,210
1899	1	1,162	4,648	71,323	26,363	115	$345	8,600	31,356
1900	2								
1901	1	1,735	8,675	7,488	29,952			9,223	38,627
1902	1	1,288	6,800	4,320	18,260			5,608	25,060
1903	1	1,519	8,127	6,842	29,079			8,361	37,206
1904	1	500	2,500	6,500	26,000			7,000	28,500
1905	1								
1906	2	4,500	27,000	15,000	45,000	1,500	3,750	21,000	75,750
1907	1			15,773	47,319			15,773	47,319
1908	1			8,600	30,100			8,600	30,100
1909	2	632	3,792	7,436	32,956			8,068	36,748
1910	2	856	5,992	12,800	70,400	8,502	25,506	22,158	101,898
1911	2	1,120	8,960	10,266	56,463	5,000	19,000	16,386	84,423
1912	2			6,108	30,540			6,108	30,540
1913	[8] 1			4,281	17,124			4,281	17,124
1914	1			9,266	50,036			9,266	50,036
1915	1			1,755	8,073			1,755	8,073
1916	1	875	7,000	3,021	15,105			3,896	22,105
1917	1			350	2,800			350	2,800
1918	1			3,000	29,800			3,000	28,800
1919	[9] 1			3,760	43,120			3,760	43,120

UMPQUA RIVER, OREG.[10]

Year	Canneries operated	Chinook Cases	Chinook Value	Silverside Cases	Silverside Value	Chum Cases	Chum Value	Total Cases	Total Value
1878	2							8,100	$43,740
1879	2								
1884	2							3,700	
1885	1							10,500	
1886	1							18,600	
1887	1							4,000	22,000
1888	1							9,000	51,750
1889	1							12,000	66,000
1891	1								
1892	1			10,000	$40,000			10,000	40,000
1893	1	809	$4,045	3,204	12,816			4,013	16,861
1894	1	235	1,175	6,875	27,500			7,110	28,675
1895	1	992	3,720	7,697	28,863			8,689	32,583
1896	1	1,300	3,900	8,000	24,000			9,300	27,900
1899	2	925	3,860	7,576	27,006	115	$345	8,616	31,211
1900	2								
1903	1	23	123	6,733	28,615			6,756	28,738
1904	1	500	2,500	9,500	38,000	500	1,000	10,500	41,500
1905	1	6,100	36,600	10,500	44,625			16,600	81,225
1906	1	1,143	6,858	5,613	16,839			6,756	23,697
1909	1	500	3,000	7,753	31,012			8,253	34,012
1910	1	2,000	14,000	11,000	60,500			13,000	74,500
1911	1	300	2,400	6,118	33,649			6,418	36,049
1912	1	30	210	3,759	18,795			3,789	19,005
1914	1	1,000	8,000	2,000	10,000			3,000	18,000
1915	2			5,100	23,460			5,100	23,460
1916	2			2,900	14,500			2,900	14,500
1917	1			5,366	42,928	47	329	5,413	43,257
1918	1	1,703	18,733	3,409	32,726	1	7	5,113	51,466
1919	1			7,500	90,000			7,500	90,000
1923	1			8,400	41,496			8,400	41,496
1924	1	1,630	10,008	15,204	85,751			16,834	95,759
1925	1	5,148	32,999	10,668	69,342			15,816	102,341
1926	1	3,183	22,281	4,067	22,287			7,250	44,568
1927	1	2,563	19,223	8,586	60,102	38	152	11,187	79,477

[8] The two canneries combined and operated one plant.
[9] Not operated since.
[10] No canning in 1913, 1920, 1921, 1922, and 1928.

Pack of canned salmon in specified years—Continued

COOS BAY AND RIVER, OREG.

Year	Canneries operated	Chinook		Silverside		Total	
		Cases	Value	Cases	Value	Cases	Value
1887	2					11,300	$62,150
1888	1					5,500	31,625
1889	1					7,000	38,500
1891	2	3					
1893	1			3,125	$12,500	3,125	12,500
1894	1	163	$815	8,428	33,712	8,591	34,527
1895	1	5,110	19,163	2,332	8,934	7,442	28,097
1896	1	13,000	39,000	2,000	6,000	15,000	45,000
1897	1	6,200	18,600	2,200	6,600	8,400	25,200
1898	2	3,142	8,169	7,180	24,412	10,322	32,581
1899	2	1,273	5,092	5,174	18,626	6,447	23,718
1900	2						
1901	1	1,215	6,075	4,082	16,328	5,297	22,403
1902	1	412	2,175	2,640	11,220	3,052	13,395
1904	1	2,033	7,725	7,200	24,480	9,233	32,205
1906	1	2,043	12,258	1,755	5,265	3,798	17,523
1909	1	275	1,475	3,959	17,927	4,234	19,402
1910	1	500	3,500	5,500	30,250	6,000	33,750
1911	2	2,630	21,040	7,260	39,930	9,890	60,970
1912	2	1,457	10,199	3,989	19,945	5,446	30,144
1913	2			7,383	29,532	7,383	29,532
1914	1			9,300	50,220	9,300	50,220
1915	1			3,500	16,100	3,500	16,100
1916	1			2,485	12,425	2,485	12,425
1917	1						
1918 [11]	1			3,800	36,480	3,800	36,480

COQUILLE RIVER, OREG.

Year	Canneries operated	Chinook Cases	Chinook Value	Silverside Cases	Silverside Value	Total Cases	Total Value
1883	1					7,000	
1884	1					7,300	
1885	1					3,800	
1886	2					8,300	
1887	3						
1888	2					11,000	$63,250
1889						8,600	47,300
1891	1						
1892	1			5,000	$20,000	5,000	20,000
1893	1			6,500	26,000	6,500	26,000
1894	[12] 1			2,000	8,000	2,000	8,000
1895	2	760	$2,887	8,724	32,615	9,484	35,502
1896	2	1,225	3,675	7,800	23,400	9,025	27,075
1898	2	541	1,407	7,485	25,499	8,026	26,906
1899	2	950	3,800	7,550	28,500	8,500	32,300
1900	1	2,636	13,180	9,601	38,404	12,237	51,584
1901	1	133	665	5,096	20,384	5,229	21,049
1902	1	286	1,510	5,877	24,927	6,163	26,437
1903	1	331	1,771	8,685	36,911	9,016	38,682
1904	2	600	2,400	13,686	54,744	14,286	57,144
1905	2	2,100	12,600	11,343	48,208	13,443	60,808
1906	2	821	4,926	17,979	53,937	18,800	58,863
1907	2	306	2,142	13,220	39,660	13,526	41,802
1908	2			19,174	67,109	19,174	67,109
1909	2	250	1,255	9,818	42,687	10,068	43,942
1910	2	420	2,940	16,637	91,504	17,057	94,444
1911	2	715	5,720	16,676	91,718	17,391	97,438
1912	2	377	2,639	6,040	30,200	6,417	32,839
1913	2			8,910	35,640	8,910	35,640
1914	2			12,097	65,324	12,097	65,324
1915	2	1,079	6,474	5,131	25,515	6,210	31,989
1916	2	869	6,952	2,652	13,260	3,521	20,212
1917	2	694	6,246	8,005	64,040	[13] 8,706	70,355
1918	2	1,318	14,498	10,096	96,922	[14] 11,650	113,129
1919	2	1,027	12,837	5,010	60,120	[15] 6,082	72,957
1920	1	541	6,492	2,862	20,349	3,403	26,841
1922	1			4,745	21,732	4,745	21,732
1923	2	228	926	10,348	51,119	10,576	52,045
1924	2	310	1,903	5,741	32,379	6,051	34,282
1925 [16]	2			1,529	9,939	1,529	9,939

[11] No canning since.
[12] Burned.
[13] Includes 7 cases of chums, valued at $49.
[14] Includes 217 cases of chums, valued at $1,519, and 19 cases of steelheads, valued at $190.
[15] Includes 45 cases of chums.
[16] No canning in 1921, nor since 1925.

Pack of canned salmon in specified years—Continued

ROGUE RIVER, OREG.[17]

Year	Canneries operated	Chinook		Silverside		Total	
		Cases	Value	Cases	Value	Cases	Value
1877	1					7,804	
1878	1					8,534	
1879	1					8,571	
1880	1					7,772	
1881	1					12,320	
1882	1					19,186	
1883	1					16,156	
1884	1					12,376	
1885	1					9,310	
1886	1					12,147	
1887	1					17,216	
1888	1					21,062	$121,107
1889	1					22,000	132,000
1890	1					24,000	120,000
1891	1					21,000	105,000
1892	1	10,000	$59,000	9,000	$36,000	19,000	95,000
1893	[18] 1	3,200	16,000			3,200	16,000
1895	1	10,377	41,508	4,385	15,347	14,762	56,855
1896	1	15,000	75,000	3,000	9,000	18,000	84,000
1897	1	15,355	61,420	3,653	10,959	19,008	72,379
1898	1	12,964	51,550	501	1,303	13,465	52,853
1899	1	5,481	30,145	1,745	6,980	7,226	37,125
1900	1						
1901	1	2,681	13,405	4,184	17,736	6,865	31,141
1902	1	3,799	20,058	4,091	17,387	7,890	37,445
1903	1	8,418	45,036	4,792	20,366	13,210	65,402
1904	1	16,000	64,000	3,255	11,392	19,255	75,392
1905	1	18,500	111,000	1,500	6,375	20,000	117,375
1906	1	12,000	72,000	6,000	18,000	18,000	90,000
1907	1	7,537	56,528	1,796	8,980	9,333	65,508
1908	1	4,354	32,655	2,650	13,250	7,004	45,905
1909	1	186	1,300	699	2,977	885	4,277
1910	1	232	1,786	2,711	16,266	2,943	18,052
1913	1	3,020	27,160	2,403	11,857	5,423	39,017
1914	1	6,938	62,060	987	5,453	7,925	67,513
1915	2	19,094	135,301	515	2,369	19,609	137,670
1916	2	22,640	181,120	501	2,505	23,141	183,625
1917	2	24,707	271,777	660	5,280	25,367	277,057
1918	2	20,469	225,159	2,704	24,336	23,173	249,495
1919	3	17,237	215,463	671	8,052	17,908	223,515
1920	3	10,205	152,565			10,205	152,565
1921	1	12,496	169,946			12,496	169,946
1922	1	10,568	145,099			10,568	145,099
1923	1	9,298	148,954			9,298	148,954
1924	1	11,880	161,449	507	2,859	12,387	164,308
1925	1	14,074	195,347	127	826	14,201	196,173
1926	1	12,285	172,236	59	323	12,344	172,559
1927	2	12,893	173,000	300	2,100	13,193	175,100
1928	2	5,411	54,110	8,136	56,942	13,547	111,052

SMITH RIVER, CALIF.[19]

Year	Canneries operated	Quinnat		Silverside		Total	
		Cases	Value	Cases	Value	Cases	Value
1878	1	4,277	$23,096			4,277	$23,096
1880	1	7,500	41,250			7,500	41,250
1884	1	5,500	33,000			5,500	33,000
1885	1	1,550	9,300			1,550	9,300
1888	1	2,347	14,082			2,347	14,082
1893	1	1,500	7,500	500	$1,500	2,000	9,000
1894	1	1,500	7,500	500	1,500	2,000	9,000
1895	1	2,250	9,990			2,250	9,990
1914	1			3,000	18,000	3,000	18,000
1915	1	1,955	13,685	1,078	6,220	3,033	19,905
1916	1	1,515	12,120	990	4,950	2,505	17,070
1917	1	6,300	69,300			6,300	69,300
1918	1	4,041	44,451	612	5,508	4,653	49,959
1919	1	4,366	56,758			4,366	56,758
1920	1	228	2,736			228	2,736
1921	1	3,000	30,180			3,000	30,180
1924	1	3,390	20,815			3,390	20,815
1925	1	6,950	44,550	750	4,875	7,700	49,425
1926	1	500	3,500			500	3,500
1927	1	2,300	17,250			2,300	17,250

[17] Shut down in 1911 and 1912 through the closing of the river to all fishing.
[18] Burned down during season. Not opened the next year.
[19] No canning in 1922, 1923, and 1928.

Pack of canned salmon in specified years—Continued

KLAMATH RIVER, CALIF.

Year	Canneries operated	Quinnat		Silverside		Total	
		Cases	Value	Cases	Value	Cases	Value
1888	1	4,400	$26,400			4,400	$26,400
1892	1	1,047	4,188			1,047	
1893	1	1,600	6,400			1,600	6,400
1894	1	1,700	6,800			1,700	6,800
1895	1	1,200	5,321	400	$1,500	1,600	6,821
1899	1	1,600	8,800			1,600	8,800
1902	1	2,500	13,500			2,500	13,500
1904	1	3,400	20,800			3,400	20,800
1909	1	5,633	33,000			5,633	33,000
1910	1	8,016	52,000			8,016	52,000
1911	1	7,400	46,000	204	816	7,604	48,816
1912	2	18,000	117,000			18,000	177,000
1913	2	6,376	40,500			6,376	40,500
1914	1	7,500	48,500	3,500	14,000	11,000	62,500
1915	1	10,400	72,800	2,500	13,000	12,900	85,800
1916	1	6,484	51,872	2,400	12,000	8,884	63,872
1917	1	5,130	56,430	2,900	23,200	8,030	79,630
1918	1	5,555	61,105	4,292	38,628	[20] 10,200	102,557
1919	1	6,291	81,783	1,145	13,740	[21] 7,731	95,523
1920	1	11,341	136,092			[22] 11,927	139,608
1921	1	7,376	74,203			7,376	74,203
1922	1	9,700	41,516			9,700	41,516
1923	1	6,000	24,360			6,000	24,360
1924	1	9,546	58,612			9,546	58,612
1925	1	14,639	93,836			14,639	93,836
1926	2	11,037	77,259			11,037	77,259
1927	2	13,285	99,638			13,285	99,638
1928	1	4,237	40,237			4,237	40,237

EEL RIVER, CALIF.[23]

Year	Canneries operated	Quinnat		Year	Canneries operated	Quinnat	
		Cases	Value			Cases	Value
1877	1	8,500	$51,000	1885	1	5,750	
1878	1	10,500	56,700	1886	1	12,500	$75,000
1880	1	6,250		1910	1	6,000	42,000
1883	1	15,000		1911	1	8,400	52,500
1884	1	8,200		1912	1	11,000	71,500

NOYO RIVER, CALIF.[24]

Year	Canneries operated	Quinnat		Silverside		Chinook		Total	
		Cases	Value	Cases	Value	Cases	Value	Cases	Value
1918	1	2,000	$22,000					2,000	$22,000
1919	1	7,500	97,500					7,500	97,500
1920	1	4,472	53,664	2,801	$19,915	1,200	$14,400	8,473	87,979

[20] Includes 353 cases of steelheads, valued at $2,824.
[21] Includes 295 cases of steelheads.
[22] Includes 586 cases of steelheads, valued at $3,516.
[23] Shut down since 1912.
[24] Cannery not operated since 1920.

Pack of canned salmon in specified years—Continued

SACRAMENTO RIVER, CALIF.[24]

Year	Canneries operated	Quinnat		Year	Canneries operated	Quinnat	
		Cases	Value			Cases	Value
1864	1	2,000		1894	2	28,463	
1865	1	2,000		1895	3	25,185	$111,821
1874		2,500		1896		13,387	
1875		3,000		1897		38,543	
1876	2	10,000		1898		29,731	
1877		21,500		1899		32,580	150,688
1878	6	34,017	$183,692	1900		39,304	
1879	4	13,855	59,577	1901		17,500	
1880	9	62,000		1902		14,043	
1881	20	181,200		1903		8,200	
1882	19	200,000		1904	2	14,407	66,936
1883	21	123,000		1905	1	2,780	
1884		81,450		1911	1	4,142	28,994
1885	6	90,000		1913	1	950	6,650
1886	9	39,300		1914	2	17,315	95,232
1887		36,500		1915	2	5,229	35,453
1888	6	68,075	423,750	1916	1	6,636	53,088
1889	3	57,300		1917	3	9,443	94,430
1890		25,065		1918	2	4,036	44,396
1891		10,353		1919	2	1,169	15,197
1892		2,281		1920	1	427	5,124
1893	3	23,336					

MONTEREY BAY, CALIF.[25]

1915	1	950	$7,300	1918			
1916	1	12,809	102,472	1919	1	2,000	$26,000
1917	1	2,000	20,000				

[24] Cannery not operated since 1920.
[25] Cannery not operated since 1919.

Pack of canned salmon in Alaska, by districts, since the inception of the industry

Year	Southeast Alaska		Central Alaska		Western Alaska		Total	
	Canneries operated	Pack	Canneries operated	Pack	Canneries operated	Pack	Canneries operated	Pack
		Cases		*Cases*		*Cases*		*Cases*
1878	2	8,159					2	8,159
1879	2	12,530					2	12,530
1880	1	6,539					1	6,539
1881	1	8,977					1	8,977
1882	1	11,501	2	10,244			3	21,745
1883	4	20,040	2	28,297			6	48,337
1884	4	22,189	2	42,297	1	[1] 400	7	64,886
1885	3	16,728	2	52,687	1	14,000	6	83,415
1886	4	18,660	2	74,583	3	48,822	9	142,065
1887	5	31,462	2	102,515	3	72,700	10	206,677
1888	6	81,128	6	241,101	4	89,886	16	412,115
1889	12	141,760	21	461,451	4	115,985	37	719,196
1890	12	142,901	19	421,300	4	118,390	35	682,591
1891	11	156,615	14	511,367	5	133,418	30	801,400
1892	7	115,722	6	295,496	2	63,499	15	474,717
1893	8	136,053	11	399,815	3	107,786	22	643,654
1894	7	142,544	10	435,052	4	108,844	21	686,440
1895	7	148,476	10	327,919	6	150,135	23	626,530
1896	9	262,381	12	485,990	8	218,336	29	966,707
1897	9	271,867	13	382,899	7	254,312	29	909,078
1898	9	251,385	14	395,009	7	318,703	30	965,097
1899	9	310,219	14	356,095	9	411,832	32	1,078,146
1900	16	456,639	14	492,223	12	599,277	42	1,548,139
1901	21	735,449	13	562,142	21	719,213	55	2,016,804

[1] Experimental pack.

Pack of canned salmon in Alaska, by districts, since the inception of the industry—Continued

Year	Southeast Alaska		Central Alaska		Western Alaska		Total	
	Canneries operated	Pack	Canneries operated	Pack	Canneries operated	Pack	Canneries operated	Pack
		Cases		*Cases*		*Cases*		*Cases*
1902	26	906, 676	12	583, 690	26	1, 016, 458	64	2, 536, 824
1903	21	642, 305	12	417, 175	27	1, 186, 730	60	2, 246, 210
1904	12	569, 003	11	499, 485	32	885, 268	55	1, 953, 756
1905	13	426, 892	9	371, 755	25	1, 089, 154	47	1, 887, 801
1906	20	767, 285	8	473, 024	19	978, 735	47	2, 219, 044
1907	22	887, 500	8	522, 836	18	759, 534	48	2, 169, 870
1908	23	1, 011, 648	8	425, 721	19	1, 169, 604	50	2, 606, 973
1909	19	852, 870	8	391, 054	18	1, 151, 553	45	2, 395, 477
1910	23	1, 066, 398	10	432, 517	19	914, 138	52	2, 413, 053
1911	32	1, 580, 868	11	499, 743	21	743, 206	64	2, 823, 817
1912	51	2, 033, 648	14	625, 062	22	1, 395, 931	87	4, 054, 641
1913	42	1, 782, 898	14	447, 249	23	1, 509, 038	79	3, 739, 185
1914	44	1, 776, 075	14	658, 791	23	1, 621, 787	81	4, 056, 653
1915	46	2, 549, 212	17	632, 848	24	1, 318, 233	87	4, 500, 293
1916	54	2, 214, 280	19	1, 075, 913	27	1, 610, 434	100	4, 900, 627
1917	62	3, 294, 845	27	1, 017, 206	29	1, 635, 235	118	5, 947, 286
1918	76	3, 375, 445	29	1, 391, 951	30	1, 838, 439	135	6, 605, 835
1919	76	3, 119, 260	30	771, 907	28	692, 521	134	4, 583, 688
1920	82	2, 225, 011	36	1, 337, 448	28	867, 004	146	4, 429, 463
1921	30	803, 071	25	643, 099	28	1, 150, 656	83	2, 596, 826
1922	57	2, 018, 743	36	988, 143	30	1, 494, 766	123	4, 501, 652
1923	65	3, 007, 119	37	743, 640	28	1, 284, 938	130	5, 035, 697
1924	65	2, 787, 789	37	1, 605, 107	28	902, 019	130	5, 294, 915
1925	62	2, 802, 414	37	1, 052, 593	30	604, 930	129	4, 459, 937
1926	61	3, 058, 055	43	2, 146, 485	28	1, 448, 342	132	6, 652, 882
1927	62	1, 052, 193	44	1, 571, 103	29	948, 832	135	3, 572, 128
1928	61	2, 971, 147	62	1, 639, 155	30	1, 473, 601	153	6, 083, 903
Total	------	53, 092, 574	------	29, 043, 182	------	35, 266, 624	------	117, 402, 380

Pack of canned salmon in Alaska from 1898 to 1928, by species

Year	Coho, or silver		Chum, or keta		Humpback, or pink	
	Cases	Value	Cases	Value	Cases	Value
1898	54, 711	----------	5, 184	----------	109, 399	----------
1899	39, 402	----------	1, 931	----------	149, 159	----------
1900	50, 984	----------	30, 012	----------	232, 022	----------
1901	65, 509	----------	47, 464	----------	541, 427	----------
1902	82, 723	----------	159, 849	----------	549, 602	----------
1903	120, 506	----------	35, 052	----------	355, 799	----------
1904	85, 741	----------	21, 178	----------	299, 333	----------
1905	67, 136	$215, 875	41, 972	$113, 056	168, 597	$498, 194
1906	109, 141	382, 109	254, 812	730, 235	348, 297	1, 046, 951
1907	85, 190	337, 384	184, 173	547, 757	561, 973	1, 799, 280
1908	68, 828	274, 089	218, 513	554, 197	644, 133	1, 733, 379
1909	56, 556	231, 029	120, 712	274, 110	464, 873	1, 114, 839
1910	114, 026	559, 666	254, 218	773, 409	554, 322	1, 764, 055
1911	133, 908	762, 647	323, 795	1, 199, 563	1, 005, 278	3, 972, 706
1912	166, 198	741, 377	664, 633	1, 584, 130	1, 280, 138	3, 296, 598
1913	75, 779	261, 654	290, 918	643, 948	1, 372, 881	3, 550, 587
1914	157, 063	690, 086	663, 859	2, 240, 765	986, 049	3, 459, 116
1915	124, 268	536, 124	479, 946	1, 243, 321	1, 875, 516	5, 217, 203
1916	261, 909	1, 399, 491	724, 115	2, 420, 600	1, 737, 793	6, 330, 185
1917	193, 231	1, 682, 745	906, 747	5, 572, 047	2, 296, 976	14, 794, 062
1918	218, 958	2, 004, 979	1, 364, 960	8, 562, 872	2, 438, 954	16, 068, 456
1919	232, 870	2, 624, 826	1, 365, 563	9, 320, 456	1, 611, 608	13, 469, 046
1920	192, 085	1, 753, 870	1, 033, 517	4, 336, 651	1, 593, 120	8, 719, 050
1921	106, 555	600, 140	255, 495	942, 525	423, 984	1, 788, 778
1922	175, 993	962, 790	565, 918	2, 251, 540	1, 658, 423	7, 189, 494
1923	164, 107	943, 318	525, 622	2, 447, 671	2, 448, 129	11, 899, 956
1924	183, 601	1, 254, 551	1, 028, 488	4, 812, 297	2, 601, 283	12, 837, 346
1925	161, 010	1, 565, 759	1, 078, 680	4, 787, 030	2, 110, 593	11, 137, 102
1926	202, 527	1, 700, 563	902, 443	4, 518, 929	3, 338, 349	17, 987, 527
1927	253, 044	2, 153, 956	507, 723	2, 777, 480	1, 420, 775	8, 338, 690
1928	298, 623	2, 125, 289	995, 785	6, 036, 466	2, 787, 242	18, 285, 530

Pack of canned salmon in Alaska from 1898 to 1928, by species—Continued

Year	King, or spring		Red, or sockeye		Total	
	Cases	Value	Cases	Value	Cases	Value
1898	12, 862		782, 941		965, 097	
1899	23, 400		864, 254		1, 078, 146	
1900	37, 715		1, 197, 406		1, 548, 139	
1901	43, 069		1, 319, 335		2, 016, 804	
1902	59, 104		1, 685, 546		2, 536, 824	
1903	47, 609		1, 687, 244		2, 246, 210	
1904	41, 956		1, 505, 548		1, 953, 756	
1905	42, 125	$141, 999	1, 567, 971	$5, 335, 547	1, 887, 801	$6, 304, 671
1906	30, 834	116, 222	1, 475, 960	5, 620, 875	2, 219, 044	7, 896, 392
1907	43, 424	181, 718	1, 295, 113	5, 915, 227	2, 169, 873	8, 781, 366
1908	23, 729	99, 867	1, 651, 770	7, 524, 251	2, 606, 973	10, 185, 783
1909	48, 034	207, 624	1, 705, 302	7, 610, 550	2, 395, 477	9, 438, 152
1910	40, 221	214, 802	1, 450, 267	7, 774, 390	2, 413, 054	11, 086, 322
1911	45, 518	295, 088	1, 315, 318	8, 363, 233	2, 823, 817	14, 593, 237
1912	43, 317	243, 331	1, 900, 355	10, 426, 481	4, 054, 641	16, 291, 917
1913	34, 370	139, 053	1, 965, 237	8, 936, 362	3, 739, 185	13, 531, 604
1914	48, 039	241, 105	2, 201, 643	12, 289, 517	4, 056, 653	18, 920, 589
1915	88, 251	408, 266	1, 932, 312	11, 248, 101	4, 500, 293	18, 653, 015
1916	65, 873	353, 420	2, 110, 937	12, 765, 733	4, 900, 627	23, 269, 429
1917	61, 951	644, 447	2, 488, 381	23, 610, 789	5, 947, 286	46, 304, 090
1918	49, 226	485, 295	2, 533, 737	23, 920, 347	6, 605, 835	51, 041, 949
1919	95, 986	1, 261, 057	1, 277, 661	16, 589, 964	4, 583, 688	43, 265, 349
1920	110, 003	1, 207, 228	1, 500, 738	19, 586, 001	4, 429, 463	35, 602, 800
1921	44, 994	459, 897	1, 765, 798	15, 841, 404	2, 596, 826	19, 632, 744
1922	30, 660	247, 673	2, 070, 658	19, 135, 696	4, 501, 652	29, 787, 193
1923	38, 343	328, 270	1, 859, 496	17, 253, 792	5, 035, 697	32, 873, 007
1924	33, 648	299, 009	1, 447, 895	13, 803, 932	5, 294, 915	33, 007, 135
1925	49, 978	595, 041	1, 059, 676	13, 904, 599	4, 459, 937	31, 989, 531
1926	52, 476	544, 246	2, 157, 087	21, 328, 739	6, 652, 882	46, 080, 004
1927	70, 391	791, 653	1, 320, 195	15, 954, 485	3, 572, 128	30, 016, 264
1928	54, 159	602, 808	1, 948, 094	18, 333, 792	6, 083, 903	45, 383, 885

Pack of canned salmon in Alaska, by districts and species 1896 to 1928

SOUTHEAST ALASKA

Year	Canneries operated	Coho		Chum		Humpback		King		Red		Total	
		Cases	Value	Cases	Value	Cases	Value	Cases	Value	Cases	Value	Cases	Value
1896	9	28,135	$95,659	452	$904	91,215	$218,916	3,787	$7,574	138,792	$527,410	262,381	$850,463
1897	9	26,769	91,015	1,396	2,792	140,506	337,214	5,973	11,946	97,223	369,447	271,867	812,414
1898	9	38,011	(1)	4,622	(1)	89,718	(1)	2,110	(1)	116,924	(1)	251,947	(1)
1899	9	28,587	(1)	1,000	(1)	138,329	(1)	7,551	(1)	134,752	(1)	310,219	(1)
1900	16	36,743	(1)	22,061	(1)	217,231	(1)	12,817	(1)	167,787	(1)	456,639	(1)
1901	21	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	735,449	(1)
1902	26	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	906,676	(1)
1903	21	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	642,305	(1)
1904	12	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	569,003	(1)
1905	13	40,821	132,790	37,685	102,207	142,008	420,614	5,460	21,733	200,918	723,937	426,892	1,401,281
1906	20	82,540	292,150	131,405	362,291	325,243	979,488	2,301	8,314	225,796	908,986	767,285	2,551,229
1907	22	58,148	233,804	140,147	407,369	533,473	1,708,441	1,275	5,353	154,457	779,265	887,500	3,134,232
1908	23	48,858	194,213	180,204	452,678	592,638	1,589,412	2,490	10,356	187,458	874,475	1,011,648	3,121,134
1909	19	39,920	160,974	83,001	186,454	455,999	1,092,389	857	3,598	273,093	1,094,423	852,870	2,537,838
1910	23	82,457	404,907	231,735	703,555	491,176	1,565,358	348	1,998	260,682	1,466,918	1,066,398	4,142,736
1911	32	99,587	573,163	287,558	1,059,326	973,494	3,846,002	1,405	8,494	218,824	1,416,241	1,580,868	6,903,226
1912	51	131,781	586,435	596,912	1,416,417	1,047,446	2,699,843	7,204	48,885	250,305	1,427,255	2,033,648	6,178,835
1913	42	56,496	196,846	257,644	563,354	1,289,737	3,338,206	1,210	5,399	177,811	881,757	1,782,898	4,985,562
1914	44	111,336	486,887	597,411	1,943,305	761,300	2,663,592	12,031	61,363	293,997	1,716,598	1,776,075	6,871,745
1915	45	90,299	386,366	373,329	967,314	1,820,191	5,074,616	27,443	124,025	237,950	1,441,516	2,549,212	7,993,837
1916	54	179,040	972,979	506,619	1,693,304	1,330,824	4,852,227	18,231	104,002	179,566	1,215,840	2,214,280	8,838,352
1917	62	151,868	1,328,759	764,902	4,673,034	2,149,570	13,914,771	23,710	282,680	204,795	2,136,791	3,294,845	22,336,035
1918	76	147,324	1,360,170	960,516	6,006,668	2,035,383	13,395,485	16,356	161,104	215,866	2,210,897	3,375,445	23,134,324
1919	76	169,514	1,920,278	1,145,725	7,739,865	1,524,522	12,765,454	30,281	368,482	249,218	3,428,989	3,119,260	26,223,068
1920	82	111,948	1,003,435	837,115	3,453,137	1,007,637	5,582,508	46,130	444,429	222,181	2,901,458	2,225,011	13,384,967
1921	30	90,802	515,222	181,447	653,317	416,781	1,759,517	9,109	95,686	104,932	1,140,708	803,071	4,164,450
1922	57	122,647	677,546	424,266	1,687,056	1,332,552	5,793,757	6,133	57,297	133,145	1,481,369	2,018,743	9,697,025
1923	65	130,351	750,236	433,376	2,037,246	2,252,019	10,965,674	13,048	123,765	178,325	1,813,035	3,007,119	15,689,956
1924	65	109,989	763,546	799,557	3,727,344	1,677,454	8,282,584	8,282	74,693	192,507	1,863,675	2,787,789	14,711,842
1925	62	91,352	912,744	847,913	3,725,218	1,707,456	9,064,709	12,005	146,279	143,688	1,902,254	2,802,414	15,751,204
1926	61	96,389	838,389	618,397	3,087,201	2,158,699	11,671,108	10,679	117,279	173,891	1,928,789	3,058,055	17,642,766
1927	62	114,970	969,570	224,433	1,245,306	588,291	3,599,256	8,031	90,727	116,468	1,535,049	1,052,193	7,439,908
1928	61	145,770	1,056,234	570,219	3,300,381	2,142,838	14,037,451	5,522	53,605	106,798	1,136,414	2,971,147	19,584,085

[1] Figures not available.

Pack of canned salmon in Alaska, by districts and species 1896 to 1928—Continued

CENTRAL ALASKA

Year	Canneries operated	Coho		Chum		Humpback		King		Red		Total	
		Cases	Value	Cases	Value	Cases	Value	Cases	Value	Cases	Value	Cases	Value
1896	12	8,882	$30,199			20,771	$49,850	7,455	$14,910	448,882	$1,705,752	485,990	$1,800,711
1897	13	6,669	22,675			14,082	33,797	5,720	11,440	356,428	1,354,426	382,899	1,422,338
1898	14	13,495	(1)	85	(1)	19,681	(1)	5,891	(1)	355,857	(1)	395,009	(1)
1899	14	10,489	(1)			10,830	(1)	7,068	(1)	327,708	(1)	356,095	(1)
1900	14	11,427	(1)	132	(1)	12,314	(1)	11,746	(1)	456,604	(1)	492,223	(1)
1901	13	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	562,142	(1)
1902	12	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	583,690	(1)
1903	12	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	417,175	(1)
1904	11	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	499,485	(1)
1905	9	16,518	51,543			3,235	9,058	6,427	20,567	345,575	1,174,615	371,755	1,255,783
1906	8	10,316	35,075			3,188	9,564	7,861	28,300	451,659	1,711,952	473,024	1,784,891
1907	8	15,258	57,980			10,255	32,458	14,355	60,291	482,968	2,191,994	522,836	2,342,723
1908	8	11,543	46,172			30,661	85,673	6,416	27,040	377,101	1,720,857	425,721	1,879,742
1909	8	10,275	43,155			5,581	13,394	16,913	74,418	358,285	1,640,910	391,054	1,771,877
1910	10	19,928	99,103	131	$403	31,797	101,380	15,786	85,235	364,875	1,959,539	432,517	2,245,660
1911	11	18,759	107,278	9,078	34,470	25,062	99,816	15,988	105,628	430,856	2,743,740	499,743	3,090,932
1912	14	19,722	89,264	29,456	72,583	137,884	355,438	14,358	79,904	423,642	2,380,302	625,062	2,977,491
1913	14	13,244	44,582	5,038	11,118	49,309	126,360	15,393	61,882	364,265	1,671,712	447,249	1,915,654
1914	14	36,863	163,887	17,723	139,618	196,368	695,015	11,168	50,711	396,669	2,256,009	658,791	3,305,240
1915	17	23,564	104,047	39,406	102,350	46,479	119,649	23,165	102,079	500,234	2,959,209	632,848	3,387,334
1916	19	53,697	282,793	64,396	204,429	370,052	1,345,957	22,013	119,405	565,755	3,522,303	1,075,913	5,474,887
1917	27	35,922	308,592	90,626	563,602	145,285	866,529	19,287	180,903	726,086	6,950,106	1,017,206	8,869,732
1918	29	59,834	535,272	300,494	1,900,437	376,222	2,484,623	15,043	145,169	640,358	6,117,657	1,391,951	11,183,158
1919	30	55,741	612,136	160,222	1,084,132	86,644	700,048	12,343	160,956	456,957	5,790,059	771,907	8,347,331
1920	36	67,241	624,417	143,300	627,983	516,977	2,749,902	22,578	213,054	587,352	7,747,031	1,377,448	11,962,387
1921	25	9,710	50,939	34,571	127,508	7,147	29,018	8,629	80,271	583,042	5,294,513	643,099	5,582,249
1922	36	40,434	217,278	91,239	362,440	312,968	1,340,799	10,165	87,047	533,337	5,319,626	988,143	7,327,190
1923	37	32,931	188,455	72,564	321,892	196,110	934,282	10,703	96,464	431,332	4,225,095	743,640	5,766,188
1924	37	69,180	464,096	192,934	912,255	892,413	4,412,557	10,531	105,018	440,049	4,173,676	1,605,107	10,067,602
1925	37	68,289	638,874	200,274	924,166	402,992	2,071,715	19,300	229,410	361,738	4,803,302	1,052,593	8,667,467
1926	43	104,309	848,128	243,808	1,233,347	1,144,180	6,141,363	23,683	254,815	630,505	6,440,686	2,146,485	14,918,339
1927	44	138,034	1,184,035	253,197	1,368,663	817,538	4,663,911	43,470	510,992	318,864	3,948,262	1,571,103	11,675,863
1928	62	152,360	1,065,619	377,857	2,446,149	643,330	4,241,394	35,036	438,385	430,572	4,290,510	1,639,155	12,482,057

WESTERN ALASKA

1896	8	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	218,336	(1)
1897	7	10,119	34,405			3,123	7,495	6,140	12,280	234,930	892,734	254,312	946,914
1898	7	3,205	(1)	477	(1)			4,861	(1)	310,160	(1)	318,703	(1)
1899	9	326	(1)	931	(1)			8,781	(1)	401,794	(1)	411,832	(1)
1900	12	2,814	(1)	7,819	(1)	2,477	(1)	13,152	(1)	573,015	(1)	599,277	(1)
1901	21	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	719,213	(1)
1902	26	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	1,046,458	(1)
1903	27	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	1,186,730	(1)
1904	32	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	885,268	(1)
1905	25	9,797	31,542	4,287	10,849	23,354	68,522	30,238	99,699	1,021,478	3,436,995	1,089,154	3,647,607
1906	19	16,278	54,884	123,407	367,944	19,866	57,899	20,680	79,608	798,504	2,999,937	978,735	3,560,272
1907	18	11,784	45,600	44,025	140,388	18,244	58,381	27,794	116,074	657,687	2,943,968	759,534	3,304,411
1908	19	8,426	33,704	38,309	101,519	20,834	58,294	14,824	62,471	1,087,211	4,928,919	1,169,604	5,184,907
1909	18	6,361	26,900	37,711	87,656	3,293	9,056	30,264	129,608	1,073,924	4,875,217	1,151,553	5,128,437
1910	19	11,641	55,656	22,352	69,451	31,348	97,317	24,087	127,569	824,710	4,347,933	914,138	4,697,926
1911	21	15,562	82,206	27,159	105,767	6,722	26,888	28,125	180,966	665,638	4,203,252	743,206	4,599,079
1912	22	14,695	65,678	38,265	95,130	94,808	241,317	21,755	114,542	1,226,408	6,618,924	1,395,931	7,135,591
1913	23	6,039	20,226	28,236	69,476	33,835	86,021	17,767	71,772	1,423,161	6,382,893	1,509,038	6,630,388
1914	23	8,864	39,312	48,725	157,842	28,381	100,509	24,840	129,031	1,510,977	8,316,910	1,621,787	8,743,604
1915	23	10,405	45,711	67,211	173,657	8,846	22,938	37,643	182,162	1,194,128	6,847,376	1,318,233	7,271,844
1916	27	29,172	143,719	153,100	522,867	36,917	132,001	25,629	130,013	1,365,616	8,027,590	1,610,434	8,956,190
1917	29	5,441	45,394	51,219	335,411	2,121	12,762	18,954	180,864	1,557,500	14,523,892	1,635,235	15,098,323
1918	30	11,800	109,537	103,950	655,767	27,349	188,318	17,827	179,022	1,677,513	15,591,793	1,838,439	16,724,467
1919	29	7,615	92,412	59,616	496,459	442	3,544	53,362	731,619	571,486	7,370,916	692,521	8,694,950
1920	28	12,896	126,018	53,102	255,531	68,506	386,640	41,295	549,775	691,205	8,937,512	867,004	10,255,446
1921	28	6,043	33,979	39,477	161,700	56	243	27,256	283,940	1,077,824	9,406,183	1,150,656	9,886,045
1922	30	12,912	67,966	50,413	202,044	12,903	54,938	14,362	103,329	1,404,176	12,334,701	1,494,766	12,762,978
1923	28	825	4,627	19,682	88,533			14,592	108,041	1,249,839	11,215,662	1,284,938	11,416,863
1924	28	4,432	26,909	35,997	172,698	31,416	142,205	14,835	119,298	815,339	7,766,581	902,019	8,227,691
1925	30	1,369	14,141	30,493	137,646	145	678	18,673	219,352	554,250	7,199,043	604,930	7,570,860
1926	28	1,829	14,046	40,238	198,381	35,470	175,056	18,114	172,152	1,352,691	12,959,264	1,448,342	13,518,899
1927	29	40	351	30,093	163,511	14,946	75,523	18,890	189,934	884,863	10,471,174	948,832	10,900,493
1928	30	493	3,436	47,709	289,936	1,074	6,685	13,601	110,818	1,410,724	12,906,868	1,473,601	13,317,743

[1] Figures not available.

Output of canned salmon in Alaska, 1913 to 1928 [1]

Product	1913	1914	1915	1916	1917	1918	1919	1920
Coho, or silver:	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*
½-pound flat	3,587	4,579	2,050	13,145	30,412	26,238	9,719	8,915
1-pound flat	266	285	2,338	8,191	362	12,786	10,438	10,746
1-pound tall	71,926	152,199	119,880	240,573	162,457	179,934	212,713	172,424
Total	75,779	157,063	124,268	261,909	193,231	218,958	232,870	192,085
Chum, or keta:								
½-pound flat	985	373	----------	1,423	26,760	3,559	3,981	53
1-pound flat	2,619	5,568	317	----------	2,530	2,996	----------	46,167
1-pound tall	287,314	657,918	479,629	722,692	877,457	1,358,405	1,361,582	987,297
Total	290,918	663,859	479,946	724,115	906,747	1,364,960	1,365,563	1,033,517
Humpback, or pink:								
½-pound flat	20,822	2,103	4,325	41,491	91,403	63,557	28,185	18,970
1-pound flat	3,258	9,286	3,508	14,796	6,014	20,215	7,553	76,017
1-pound tall	1,348,801	974,660	1,867,683	1,681,506	2,199,559	2,355,182	1,575,870	1,498,133
Total	1,372,881	986,049	1,875,516	1,737,793	2,296,976	2,438,954	1,611,608	1,593,120
King, or spring:								
½-pound flat	1,585	3,143	2,404	2,617	12,973	6,000	7,584	10,196
1-pound flat	----------	4,804	3,755	3,804	5,133	5,267	11,532	18,319
1-pound tall	32,785	40,092	82,092	59,452	43,845	37,959	76,870	81,488
Total	34,370	48,039	88,251	65,873	61,951	49,226	95,986	110,003
Red, or sockeye:								
½-pound flat	29,041	53,825	52,033	81,565	124,309	137,008	122,236	101,716
1-pound flat	11,735	64,671	112,847	86,395	89,612	151,864	110,491	120,147
1-pound tall	1,924,461	2,083,147	1,765,139	1,936,971	2,274,460	2,244,865	1,044,934	1,278,875
1½-pound nominals	----------	----------	2,293	----------	----------	----------	----------	----------
2-pound nominals	----------	----------	----------	6,006	----------	----------	----------	----------
Total	1,965,237	2,201,643	1,932,312	2,110,937	2,488,381	2,533,737	1,277,661	1,500,738
Grand total	3,739,185	4,056,653	4,500,293	4,900,627	5,947,286	6,605,835	4,583,688	4,429,463

Product	1921	1922	1923	1924	1925	1926	1927	1928
Coho, or silver	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*
½-pound flat	4,084	22,237	13,866	8,059	7,145	10,354	10,105	13,498
1-pound flat	7,918	12,099	10,151	5,403	7,223	16,625	15,047	5,840
1-pound tall	94,553	141,657	140,090	170,139	146,642	175,548	227,892	279,285
Total	106,555	175,993	164,107	183,601	161,010	202,527	253,044	298,623
Chum, or keta:								
½-pound flat	608	3,698	6,356	346	3,051	1,367	9,414	5,057
1-pound flat	----------	6,185	16	630	----------	48,982	1,449	4
1-pound tall	254,887	556,035	519,250	1,027,512	1,075,629	852,094	496,860	990,724
Total	255,495	565,918	525,622	1,028,488	1,078,680	902,443	507,723	995,785
Humpback, or pink:								
½-pound flat	1,292	42,736	29,363	21,365	34,005	59,835	50,455	40,473
1-pound flat	----------	30,879	9,428	13,095	185	82,161	14,662	6,189
1-pound tall	422,692	1,584,808	2,409,338	2,566,823	2,076,403	3,196,353	1,355,658	2,740,580
Total	423,984	1,658,423	2,448,129	2,601,283	2,110,593	3,338,349	1,420,775	2,787,242
King, or spring:								
½-pound flat	4,061	3,770	5,466	1,501	2,755	3,324	10,528	11,782
1-pound flat	19,192	3,967	7,281	9,500	8,828	11,125	11,371	14,854
1-pound tall	21,741	22,923	25,596	22,647	38,395	38,027	48,492	27,523
Total	44,994	30,660	38,343	33,648	49,978	52,476	70,391	54,159
Red, or sockeye:								
½-pound flat	60,831	171,896	121,775	31,947	68,901	82,181	88,874	89,063
1-pound flat	71,108	121,449	159,271	110,352	28,757	104,329	57,771	87,100
1-pound tall	1,633,859	1,777,313	1,578,450	1,305,596	962,018	1,970,577	1,173,550	1,771,931
Total	1,765,798	2,070,658	1,859,496	1,447,895	1,059,676	2,157,087	1,320,195	1,948,094
Grand total	2,596,826	4,501,652	5,035,697	5,294,915	4,459,937	6,652,882	3,572,128	6,083,903

[1] The number of cases shown has been put upon the common basis of forty-eight 1-pound cans per case.

Average annual price per case of forty-eight 1-pound cans of Alaska salmon, 1908 to 1928

Product	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918
Coho, or silver	$3.98	$4.07	$4.89	$5.67	$4.44	$3.45	$4.39	$4.31	$5.34	$8.76	$9.15
Chum, or keta	2.53	2.28	3.04	3.72	2.37	2.21	3.37	2.59	3.34	6.14	6.27
Humpback, or pink	2.69	2.40	3.15	3.91	2.55	2.58	3.50	2.78	3.64	6.44	6.58
King, or spring	4.20	4.32	5.34	6.48	5.37	4.04	5.01	4.63	5.36	10.40	9.85
Red, or sockeye	4.52	4.53	5.30	6.33	5.45	4.54	5.58	5.82	6.04	9.48	9.44

Product	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
Coho, or silver	$11.27	$9.13	$5.63	$5.47	$5.74	$6.83	$9.72	$8.40	$8.51	$7.12
Chum, or keta	6.82	4.19	3.68	3.98	4.65	4.68	4.44	5.01	5.47	6.06
Humpback, or pink	8.35	5.47	4.21	4.34	4.86	4.93	5.28	5.39	5.87	6.56
King, or spring	13.13	10.97	10.22	8.08	8.56	8.89	11.91	10.37	11.25	11.13
Red, or sockeye	12.98	13.05	8.96	9.24	9.27	9.53	13.12	9.89	12.08	9.41

Pack of canned salmon in British Columbia since the inception of the industry, by waters

Year	Canneries operated	Fraser River	Skeena River	Rivers Inlet and Smiths Inlet	Naas River	Outlying districts	Total
		Cases	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*
1876	2	7,247					7,247
1877	5	55,387	3,000				58,387
1878	8	81,446	8,500				89,946
1879	9	50,490	10,603				61,093
1880	9	42,155	19,694				61,849
1881	11	142,516	21,560			5,500	169,576
1882	16	199,204	24,522	5,635	6,500	4,600	240,461
1883	20	105,701	31,157	10,780	9,400	6,400	163,438
1884	14	34,037	53,786	20,383	8,500	7,000	123,706
1885	9	89,617	12,900			6,000	108,517
1886	16	99,177	37,587	15,000		1,200	152,964
1887	20	130,088	58,592	11,203		4,200	204.083
1888	21	76,616	70,106	20,000	12,318	5,000	184,040
1889	28	310,122	58,405	21,722	19,800	7,162	417,211
1890	33	244,352	91,645	33,500	24,700	17,060	411,257
1891	38	177,989	77,057	36,500	11,058	11,907	314,511
1892	36	98,491	90,750	14,955	26,100	18,425	248,721
1893	44	474,237	59,021	35,416	15,680	25,848	610,202
1894	42	363,566	61,005	40,161	20,000	7,500	492,232
1895	49	432,920	69,356	58,575	20,541	6,300	587,692
1896	56	375,344	97,863	107,473	14,649	22,453	617,782
1897	65	879,776	61,310	40,090	20,000	26,007	1,027,183
1898	67	264,225	80,102	105,362	20,000	22,862	492,551
1899	68	527,396	112,562	76,428	19,442	29,691	765,519
1900	69	331,371	135,424	74,196	20,200	45,349	606,540
1901	78	998,913	125,845	66,794	15,004	40,656	1,247,212
1902	69	327,197	155,936	70,298	23,212	50,518	627,161
1903	61	237,125	98,669	69,390	12,100	56,390	473,674
1904	51	128,903	154,869	94,292	19,085	68,745	465,894
1905	64	877,136	114,085	83,122	32,725	60,392	1,167,460
1906	59	240,486	162,420	122,878	32,534	71,142	629,460
1907	42	163,116	159,255	94,064	31,832	99,192	547,459
1908	50	89,184	209,177	75,090	46,908	122,330	542,689
1909	86	567,203	140,739	91,014	40,990	127,974	967,920
1910	58	223,148	222,035	129,398	39,720	147,900	762,201
1911	59	301,344	254,410	101,066	65,684	226,461	948,965
1912	57	173,921	254,258	137,697	71,162	359,538	996,576
1913	78	732,059	164,055	68,096	53,423	336,268	1,353,901
1914	63	328,390	237,634	109,052	94,890	341,073	1,111,039
1915	63	289,199	279,161	146,838	104,289	313,894	1,133,381
1916	73	106,440	223,158	85,383	126,686	453,398	995,065
1917	90	377,988	292,219	95,302	119,495	672,481	1,557,485
1918	83	206,003	374,216	103,155	143,908	788,875	1,616,157
1919	74	158,718	398,877	80,367	97,512	657,682	1,393,156
1920	50	132,860	334,392	152,828	81,153	486,383	1,187,616
1921	49	103,919	234,765	56,957	51,765	156,142	603,548
1922	50	137,482	482,305	86,828	124,071	459,640	1,290,326
1923	51	224,637	338,863	127,774	99,580	550,823	1,341,677
1924	50	208,516	390,858	114,314	142,939	888,686	1,745,313
1925	46	272,993	348,859	197,087	89,008	811,335	1,719,282
1926	54	272,860	407,524	108,148	92,749	1,183,909	2,065,190
1927	48	280,041	187,716	98,331	39,828	754,718	1,360,634
1928	36	255,455	298,709	111,066	104,877	1,265,522	2,035,629
Total		14,008,706	8,391,516	3,604,008	2,266,017	11,832,531	40,102,778

Number of salmon canneries operated in various sections of British Columbia in recent years

Year	Fraser River	Naas River	Skeena River	Rivers Inlet and Smiths Inlet	Outlying districts	Total
1910	23	4	12	7	12	58
1911	22	4	12	7	14	59
1912	18	4	12	7	16	57
1913	36	4	13	7	18	78
1914	21	5	13	7	17	63
1915	22	5	13	7	16	63
1916	23	5	14	8	23	73
1917	29	6	14	9	32	90
1918	16	7	15	9	36	83
1919	11	7	15	9	32	74
1920	11	5	15	10	23	64
1921	13	5	13	10	15	56
1922	10	5	13	10	26	64
1923	11	5	13	10	22	61
1924	9	4	13	10	24	60
1925	10	3	13	11	28	65
1926	10	4	15	12	35	76
1927	10	4	13	13	36	76
1928	9	4	13	12	42	80

Pack, by districts and species, of canned salmon in British Columbia from 1903 [1] *to 1919*

District and species	1903	1904	1905	1906	1907	1908
Fraser River district:	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*
Chums		1,066				
Cohos	25,728	45,667	30,836	34,413	35,766	24,198
Pinks	4,504		3,304	15,543	63,530	415
Sockeyes	204,809	72,688	837,489	183,007	59,815	63,126
Springs, red	2,084	9,482	5,507	6,503	3,448	1,427
Springs, white				1,020	557	18
Total	237,125	128,903	877,136	240,486	163,116	89,184
Skeena River district:						
Chums		35,329				
Cohos	9,648	5,515	7,247	16,897	15,247	10,085
Pinks	20,045		7,523	38,991	25,217	45,404
Sockeyes	50,968	93,404	84,717	86,394	108,413	139,846
Springs, red	18,008	20,621	14,598	20,138	10,378	13,374
Springs, white						468
Total	98,669	154,869	114,085	162,420	159,255	209,177
Rivers Inlet and Smiths Inlet district:						
Chums		61				
Cohos	219	358		66	5,040	9,505
Pinks	180				700	479
Sockeyes	68,119	93,862	82,771	122,631	87,874	64,652
Springs, red	872	11	351	181	450	454
Total	69,390	94,292	83,122	122,878	94,064	75,090
Naas River district:						
Chums		31				
Cohos	2,187	1,697	3,083	5,997	6,093	8,348
Pinks			1,840	3,450	5,957	6,612
Sockeyes	8,438	15,000	24,462	22,166	17,813	27,584
Springs, red	1,475	2,357	3,340	858	1,288	3,263
Springs, white				63		
Steelheads					681	1,101
Total	12,100	19,085	32,725	32,534	31,832	46,908
Outlying districts:						
Chums		1,155				
Cohos	14,136	13,114	3,292	11,759	25,754	29,781
Pinks	2,653		1,303	10,321	23,300	23,538
Sockeyes	36,383	48,272	51,234	45,481	40,159	59,815
Springs, red	3,218	6,204	4,563	3,581	7,595	6,915
Springs, white					2,382	2,245
Steelheads					2	36
Total	56,390	68,745	60,392	71,142	99,192	122,330

[1] In 1901 in the Fraser River district 920,313 cases of sockeyes were packed, and in 1902 sockeyes were packed as follows: 293,477 cases in Fraser River district, 117,677 cases in Skeena River district, 68,819 cases in Rivers Inlet district, 20,953 cases in Naas River district, and 30,510 cases in outlying districts.

Pack, by districts and species, of canned salmon in British Columbia from 1903 to 1919—Continued

District and species	1903	1904	1905	1906	1907	1908
TOTAL BY SPECIES	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*
Chums		37, 642				
Cohos	51, 918	66, 351	44, 458	69, 132	87, 900	81, 917
Pinks	27, 382		13, 970	[2] 68, 305	[2] 118, 704	[2] 76, 448
Sockeyes	368, 717	323, 226	1, 080, 673	459, 679	314, 074	355, 023
Springs, red	25, 657	38, 675	28, 359	31, 261	23, 159	25, 433
Springs, white				1, 083	2, 939	2, 731
Steelheads					683	1, 137
Grand total	473, 674	465, 894	1, 167, 460	629, 460	547, 459	542, 689

District and species	1909	1910	1911	1912	1913	1914
Fraser River district:	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*
Chums		52, 177	47, 237	12, 961	22, 220	74, 726
Cohos	21, 540	27, 855	39, 740	28, 574	11, 648	38, 639
Pinks	1, 987	128	142, 101	574	9, 973	6, 057
Sockeyes	542, 248	133, 045	58, 487	108, 784	684, 596	185, 483
Springs, red	1, 428	1, 018	7, 028	14, 655	3, 573	9, 485
Springs, white		8, 925	6, 751	8, 373	49	14, 000
Total	567, 203	223, 148	301, 344	173, 921	732, 059	328, 390
Skeena River district:						
Chums			70	504		8, 329
Cohos	12, 249	11, 531	23, 376	39, 628	18, 647	16, 378
Pinks	28, 120	13, 473	81, 956	97, 588	66, 045	71, 021
Sockeyes	87, 901	187, 246	131, 066	92, 498	52, 927	130, 166
Springs, red	11, 727	9, 546	15, 514	19, 332	23, 250	11, 529
Springs, white	742	239	2, 428	4, 501	3, 186	211
Steelheads				207		
Total	140, 739	222, 035	254, 410	254, 258	164, 055	237, 634
Rivers Inlet and Smith's Inlet district:						
Chums			288	3, 845		5, 023
Cohos	1, 400	2, 075	6, 287	11, 010	3, 660	7, 789
Pinks		19	5, 411	8, 809	2, 097	5, 784
Sockeyes	89, 027	126, 921	88, 763	112, 884	61, 745	89, 890
Springs, red	587	383	317	681	594	566
Springs, white				468		
Total	91, 014	129, 398	101, 066	137, 697	68, 096	109, 052
Naas River district:						
Chums		351	5, 189	3, 245	2, 987	25, 569
Cohos	6, 818	6, 285	7, 842	12, 468	3, 172	9, 276
Pinks	3, 589	895	11, 467	12, 476	20, 539	25, 333
Sockeyes	28, 246	30, 810	37, 327	36, 037	23, 574	31, 327
Springs, red	2, 280	1, 228	3, 434	5, 710	2, 999	2, 660
Springs, white	57	11	325	1, 226	152	725
Steelheads		140	100			
Total	40, 990	39, 720	65, 684	71, 162	53, 423	94, 890
Outlying districts:						
Chums		5, 834	39, 167	37, 770	52, 758	70, 827
Cohos	19, 911	26, 636	42, 457	73, 422	32, 695	48, 119
Pinks	12, 848	20, 098	64, 312	128, 296	94, 233	112, 145
Sockeyes	93, 019	87, 893	67, 866	94, 559	149, 336	99, 830
Springs, red	2, 196	7, 138	12, 458	21, 967	7, 017	8, 668
Springs, white		301	201	3, 524	229	1, 484
Total	127, 974	147, 900	226, 461	359, 538	336, 268	341, 073
TOTAL BY SPECIES						
Chums		58, 362	91, 951	58, 325	77, 965	184, 474
Cohos	61, 918	74, 382	119, 702	165, 102	69, 822	120, 201
Pinks	[2] 46, 544	34, 613	305, 247	247, 743	192, 887	220, 340
Sockeyes	840, 441	565, 915	383, 509	444, 762	972, 178	536, 696
Springs, red	18, 218	19, 313	38, 751	62, 345	37, 433	32, 908
Springs, white	799	9, 476	9, 705	18, 092	3, 616	16, 420
Steelheads		140	100	207		
Grand total	967, 920	762, 201	948, 965	996, 576	1, 353, 901	1, 111, 039

[2] Pinks and chums combined.

Pack, by districts and species, of canned salmon in British Columbia from 1903 to 1919—Continued

District and species	1915	1916	1917	1918	1919
Fraser River district:	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*
Chums	18,539	30,184	59,973	86,215	15,718
Cohos	34,114	27,676	30,735	43,871	54,866
Pinks	128,555	840	134,442	18,388	39,363
Sockeyes	89,040	27,394	123,614	16,849	29,628
Springs, red	15,388	11,096	10,197	15,192	15,223
Springs, white	3,532	9,217	18,916	24,853	3,592
Steelheads	31	33	111	635	328
Total	289,199	106,440	377,988	206,003	158,718
Skeena River district:					
Chums	5,769	17,121	21,516	22,573	31,457
Cohos	32,190	47,409	38,456	38,759	36,559
Pinks	107,578	73,029	148,319	161,727	117,303
Sockeyes	116,553	60,923	65,760	123,322	184,945
Springs, red	15,069	18,372	13,586	16,013	23,285
Springs, white	204	2,561	2,699	6,828	2,656
Steelheads	1,798	3,743	1,883	4,994	2,672
Total	279,161	223,158	292,219	374,216	398,877
Rivers Inlet and Smith's Inlet district:					
Chums	5,387	20,144	16,101	6,729	7,089
Cohos	7,115	15,314	9,124	12,074	9,038
Pinks	2,964	3,567	8,065	29,542	6,538
Sockeyes	130,350	44,936	61,195	53,401	56,258
Springs, red	1,022	1,033	715	957	1,201
Springs, white	----------	389	102	452	241
Steelheads	----------	----------	----------	----------	2
Total	146,838	85,383	95,302	103,155	80,367
Naas River district:					
Chums	11,076	11,200	24,938	40,368	24,041
Cohos	15,171	19,139	22,180	17,061	10,900
Pinks	34,879	59,593	44,568	59,206	29,949
Sockeyes	39,349	31,411	22,188	21,816	28,259
Springs, red	3,053	3,061	3,170	2,332	2,993
Springs, white	648	784	1,326	1,820	581
Steelheads	113	1,498	1,125	1,305	789
Total	104,289	126,686	119,495	143,908	97,512
Outlying districts:					
Chums	41,229	161,552	352,745	341,730	293,730
Cohos	58,366	77,181	64,814	87,359	88,630
Pinks	93,376	143,615	161,365	258,882	153,486
Sockeyes	100,750	50,125	67,091	61,071	70,355
Springs, red	17,202	17,669	20,962	31,041	39,554
Springs, white	1,986	2,544	4,603	7,866	11,225
Steelheads	985	712	901	926	702
Total	313,894	453,398	672,481	788,875	657,682
TOTAL BY SPECIES					
Chums	82,000	240,201	475,273	497,615	372,035
Cohos	146,956	186,719	165,309	199,124	199,993
Pinks	367,352	280,644	496,759	527,745	346,639
Sockeyes	476,042	214,789	339,848	276,459	369,445
Springs, red	51,734	51,231	48,630	65,535	82,256
Springs, white	6,370	15,495	27,646	41,819	18,295
Steelheads	2,927	5,986	4,020	7,860	4,493
Grand total	1,133,381	995,065	1,557,485	1,616,157	1,393,156

Pack by districts and species, of canned salmon in British Columbia from 1920 to 1928

District and species	1920	1921	1922	1923	1924	1925	1926	1927	1928
	Cases	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*
Fraser River district:									
Bluebacks	4, 488	1, 323	812	--------	1, 757	5, 107	13, 736	10, 627	795
Chums	23, 884	11, 223	17, 895	103, 248	109, 495	66, 111	88, 495	67, 259	193, 106
Cohos	22, 934	29, 978	23, 587	20, 173	21, 401	36, 717	21, 783	24, 079	27, 061
Pinks	12, 839	8, 178	29, 578	63, 645	31, 968	99, 800	32, 256	102, 536	2, 881
Sockeyes	44, 598	35, 900	48, 744	29, 423	36, 200	31, 523	83, 598	57, 056	26, 530
Springs, red	24, 083	17, 309	12, 994	4, 518	3, 574	7, 989	12, 783	7, 925	1, 173
Springs, white	--------	--------	3, 867	3, 615	4, 056	25, 701	20, 169	10, 528	3, 909
Steelheads	34	8	5	15	65	45	40	31	--------
Total	132, 860	103, 919	137, 482	224, 637	208, 516	272, 993	272, 860	280, 041	255, 455
Skeena River district:									
Chums	3, 834	1, 993	39, 758	16, 527	25, 588	74, 308	63, 527	19, 006	17, 716
Cohos	18, 068	45, 033	24, 699	31, 967	26, 968	39, 168	30, 208	26, 326	30, 194
Pinks	177, 679	124, 457	301, 655	145, 973	181, 313	130, 079	210, 081	38, 768	209, 579
Sockeyes	90, 869	41, 018	100, 667	131, 731	144, 747	81, 146	82, 360	83, 996	34, 559
Springs, red	42, 724	21, 766	12, 671	11, 748	10, 727	18, 205	18, 352	17, 636	5, 696
Springs, white	--------	--------	1, 805	499	1, 301	5, 240	2, 242	1, 402	724
Steelheads	1, 218	498	1, 050	418	214	713	754	582	241
Total	334, 392	234, 765	482, 305	338, 863	390, 858	348, 859	407, 524	187, 716	298, 709
Rivers Inlet and Smiths Inlet:									
Bluebacks	--------	--------	82	--------	--------	--------	--------	--------	--------
Chums	1, 226	173	311	3, 242	4, 924	11, 510	11, 758	3, 727	3, 613
Cohos	2, 908	4, 718	1, 120	1, 526	1, 980	4, 946	7, 450	5, 084	1, 098
Pinks	25, 647	5, 305	24, 292	10, 057	15, 105	8, 625	13, 504	1, 403	16, 713
Sockeyes	121, 254	46, 300	60, 700	112, 350	91, 760	171, 510	74, 628	87, 143	88, 875
Springs, red	1, 793	364	285	499	414	444	662	748	283
Springs, white	--------	--------	38	100	131	52	135	209	471
Steelheads	--------	97	--------	--------	--------	--------	11	17	13
Total	152, 828	56, 957	86, 828	127, 774	114, 314	197, 087	108, 148	98, 331	111, 066
Naas River:									
Bluebacks	--------	--------	42	--------	--------	--------	--------	--------	--------
Chums	12, 145	2, 176	11, 277	25, 791	26, 612	22, 504	15, 392	3, 307	3, 538
Cohos	3, 700	8, 236	3, 533	7, 894	6, 481	8, 027	4, 274	3, 966	10, 734
Pinks	43, 151	29, 488	75, 687	44, 165	72, 496	35, 530	50, 815	16, 609	83, 183
Sockeyes	16, 740	9, 364	31, 277	17, 821	33, 590	18, 945	15, 929	12, 026	5, 540
Springs, red	4. 857	2, 088	1, 807	2, 979	2, 350	3, 365	5, 367	3, 545	1, 539
Springs, white	--------	--------	255	335	375	392	597	279	307
Steelheads	560	413	193	595	1, 035	245	375	96	36
Total	81, 153	51, 765	124, 071	99, 580	142, 939	89, 008	92, 749	39, 828	104, 877
Outlying districts:									
Bluebacks	3, 573	5, 737	5, 495	7, 097	2, 510	4, 832	5, 409	10, 194	5, 277
Chums	43, 537	55, 843	188, 963	269, 247	402, 297	432, 776	523, 065	469, 895	645, 257
Cohos	54, 362	29, 323	49, 906	50, 484	58, 892	100, 016	98, 734	103, 277	81, 570
Pinks	261, 540	25, 478	150, 767	177, 092	356, 656	172, 131	466, 356	88, 310	480, 016
Sockeyes	77, 944	31, 332	58, 226	43, 322	63, 306	89, 394	80, 497	67, 831	48, 038
Springs, red	44, 844	8, 225	5, 319	2, 653	3, 949	9, 306	7, 485	11, 425	3, 352
Springs, white	--------	--------	555	196	579	1, 360	1, 387	2, 821	1, 437
Steelheads	583	204	409	732	497	1, 520	976	965	575
Total	486, 383	156, 142	459, 640	550, 823	888, 686	811, 335	1, 183, 909	754, 718	1, 265, 522
TOTAL BY SPECIES									
Bluebacks	8, 061	7, 060	6, 431	7, 097	4, 267	9, 939	19, 145	20, 821	6, 072
Chums	84, 626	71, 408	258, 204	418, 055	568, 916	607, 209	702, 237	563, 194	863, 230
Cohos	101, 972	117, 288	102, 845	112, 044	115, 722	188, 874	162, 449	162, 732	150, 657
Pinks	520, 856	192, 906	581, 979	440, 932	657, 538	446, 165	773, 012	247, 626	792, 372
Sockeyes	351. 405	163, 914	299, 614	334, 647	369, 603	392, 518	337, 012	308, 052	203, 542
Springs, red	118, 301	49, 752	33, 076	22, 397	21, 014	39, 309	44, 649	41, 279	12, 043
Springs, white	--------	--------	6, 520	4, 745	6, 442	32, 745	24, 530	15, 239	6, 848
Steelheads	2, 395	1, 220	1, 657	1, 760	1, 811	2, 523	2, 156	1, 691	865
Grand total	1, 187, 616	603, 548	1, 290, 326	1, 341, 677	1, 745, 313	1, 719, 282	2, 065, 190	1, 360, 634	2, 035, 629

MARKET PRICES FOR CANNED SALMON

The manner of fixing the selling price at which the canner is willing to dispose of his canned product varies slightly in certain regions. In May or June, when the spring-packing season has sufficiently advanced so that a line can be gotten on the probable pack of chinook, the highest priced of the pack, the Columbia River canners agree upon a price, this usually being high or low, as the pack is small or large.

Since the Alaska Packers Association was formed, through a combination of a number of canneries operating in the Territory of Alaska, it has packed in some years as much as one-fourth of the salmon canned. It also owns canneries on Puget Sound.

The custom grew up amongst the smaller packers of Alaska and Puget Sound of waiting until the association fixed the prices on its own pack, when the others would generally fall into line with the same prices for their packs. At no time has it ever been compulsory on the part of any packer to adopt the same prices as the association. In fact, it has sometimes been the case that, while the small packer publicly quoted the association's opening prices, yet in secret he was shading it by 2½ to 5 cents per dozen on certain grades.

Occasionally the other packers do not like a certain quotation of the association and make one more nearly in consonance with their own views. This happened in 1913, when the association quoted 60 cents for chums, while the Puget Sound canners quoted 55 cents for this grade, and in 1915 when the association quoted 65 cents for chums and the Puget Sound interests 70 cents for the same grade, thus showing clearly the independence of the smaller packers.

Owing to a peculiar feature of the salmon marketing business, more depends upon the opening prices than appears on the surface to the uninitiated.

Shortly after the first of the year buyers throughout the world begin to take stock of their salmon supplies and shortly thereafter begin placing their "future" orders. These cover the quantity required of each grade, and when the buyer orders through a broker the orders are placed subject to a contract similar to the following:

> The undersigned hereby authorizes ——— to book the number of cases of canned salmon specified below; said booking to be filed with packers for delivery from ——— (naming year) pack, subject to buyers' approval of opening prices when named; *the option being granted buyers of confirming the total number* of cases specified below; *confirming a smaller quantity*, or *declining any confirmation.* ——— furthermore agrees that *buyers shall have the option of increasing quanities* listed below, when he names opening prices for his packers, contingent upon his ability to secure at that time an increased allotment from his packers. In event ——— secures an increased allotment from his packers insufficient to meet all increases requested by his patrons, he will distribute such increase as he can secure among the dealers who have filed conditional contracts with him, according to the date order that said contracts have been received in his office.

Under this form of contract the packer is expected to be ready to fulfill the terms of same, except in case of a short pack, when the orders are generally prorated; i. e., all orders are proportionately reduced until they come within the compass of the pack. Should the buyer dislike the opening price he has the privilege of canceling the order. While this latter privilege may not, at first glance, look just to the packer, yet it is doubtful if any buyer would place a "future" order unless he was assured of a chance to cancel it should he feel that too high a sum was fixed in the opening prices.

Some canneries contract to sell their entire output to one buyer, and the price fixed is usually the opening prices for the year in question. In such cases the buyer and seller are both compelled to abide by the price, no matter how unjust one or the other may consider it.

The announcement of opening prices does not occur ordinarily until late in August or early in September, when the greater part of the packing is over with and a good line on the total pack has been obtained.

AMERICAN OPENING PRICES

Below are shown the yearly opening prices on the various grades and sizes from 1890 to 1928. The most interesting part of this is the increase shown in the value of high-grade salmon. Columbia River chinook was quoted at $1.05 for 1-pound talls in 1897, and it gradually advances until in 1928 it is quoted at $4.15. Alaska red 1-pound talls in 1897 sold for 90 cents, the lowest during the period in question, advancing, with occasional recessions, until in 1925 it reached high-water mark of $3.50. In 1897 Puget Sound 1-pound tall sockeye sold for 80 cents, 10 cents below Alaska red. In 1898 it sold for 20 cents less than reds. In 1902 it sold for $1 as compared with 95 cents for Alaska red, and from that time on brought a higher price, being quoted at $4.25 in 1922 as compared with $2.25 for Alaska red. No sockeye 1-pound talls were packed since 1922.

Medium red or coho does not figure in the opening prices until 1908, when Puget Sound coho sold for 5 cents a dozen more than Alaska coho. Very shortly thereafter, however, both were classed together and sold for the same price. This grade has not had the wide fluctuations of the others, due mainly to the generally small pack made annually.

Pink salmon has been the football of the salmon market ever since the pack became of sufficient size to become a feature in it. The size of the pack has been steadily increasing, as the fish became better known, and while the price obtained has been excellent in certain years (in 1911 it sold at $1 per dozen, the highest point reached up to that time), usually the price has been low. In 1897 it was quoted at 65 cents. In 1915 the opening price was 75 cents, but as a matter of fact a large part of the pack really sold for 65 cents. The lowest point it reached was in 1903, when it was quoted at 50 cents a dozen. As a result of the demand created by the war pink salmon opened at 90 cents in 1916, $1.65 in 1917 and 1918, and $2.25 in 1919. The market collapsed under the last-named price, however, and since 1919 the average opening price has been $1.35.

It is only of recent years that chum salmon has become a factor in the market. Although sold for some time before then, chum salmon appears first in the regular opening prices in 1908, when it was quoted at 70 cents a dozen. In 1913 it was quoted at 55 cents while the opening price in 1915 was 70 cents on Puget Sound and 65 cents at San Francisco. During the war the opening prices on chums were materially increased, being 85 cents in 1916, $1.60 in 1917, $1.75 in 1918, and $2.15 in 1919. As in the case of pinks, the market collapsed under the 1919 price, and some sales under $1 were made in 1920. The following years the prices showed no appreciable gain until 1928 when chum salmon was quoted at $1.60.

The pack of Alaska and Puget Sound kings or springs has always been small, and while they have always been quoted at $1 per dozen or better (in 1919 they were quoted at $3.12½) they have always been slow sellers. It is extremely improbable that the canned pack will increase much in the future, as this fish is the best for mild curing, and as the mild curers are able to offer better prices for the raw fish than the canneries, they will always get the fish when desired.

American opening prices per dozen cans since 1890

1890 to 1902

Year and species	Talls	Year and species	Talls	Year and species	Talls
1890		1895		1899	
Columbia River chinook	$1.40	Columbia River chinook	$1.32½	Columbia River chinook	$1.25
Alaska red	1.20	Alaska red	1.15	Alaska red	1.10
Alaska pink	.75	Alaska pink	.80	Puget Sound sockeye	1.10
1891		1896		Alaska pink	.67½
Columbia River chinook	1.35	Columbia River chinook	1.25	1900	
Alaska red	1.20	Alaska red	1.10	Columbia River chinook	1.60
Alaska pink	.75	Alaska pink	.75	Alaska red	1.25
1892		1897		Puget Sound sockeye	1.10
Columbia River chinook	1.35	Columbia River chinook	1.05	Alaska pink	.75
Alaska red	1.15	Alaska red	.95	1901	
Alaska pink	.75	Puget Sound sockeye	.80	Columbia River chinook	1.50
1893		Alaska pink	.65	Alaska red	1.25
Columbia River chinook	1.32½	1898		Puget Sound sockeye	.95
Alaska red	1.17½	Columbia River chinook	1.05	Alaska pink	.75
Alaska pink	.65	Alaska red	.97½	1902	
1894		Puget Sound sockeye	.80	Columbia River chinook	1.35
Columbia River chinook	1.35	Alaska pink	.65	Alaska red	1.00
Alaska red	1.10			Puget Sound sockeye	1.00
Alaska pink	.60			Alaska pink	.65

1903 to 1928

Year and species	Talls	Flats	Halves	Year and species	Talls	Flats	Halves
1903				1907			
Puget Sound sockeye	$1.50	$1.60	$0.90	Columbia River chinook	$1.65	$1.75	$1.05
Columbia River chinook	1.35	1.45	.85	Puget Sound sockeye	1.60	1.75	1.10
Alaska red	1.30			Alaska red	1.15		
Alaska pink	.50			Alaska pink	.80		
1904				1908			
				Columbia River chinook	1.65	1.75	1.05
Columbia River chinook	1.45	1.15	.90	Puget Sound sockeye	1.60	1.75	1.05
Puget Sound sockeye	1.55	1.65	.95	Puget Sound pink	.75	.80	
Alaska red	1.30			Puget Sound coho	1.05	1.15	.75
Alaska pink	.70			Alaska red	1.15		
1905				Alaska king	1.05		
				Alaska coho	1.00		
				Alaska pink	.70		
Columbia River chinook	1.45	1.55	.90	Alaska chum	.70		
Puget Sound sockeye	1.35	1.50	4.00	1909			
Alaska red	1.00			Columbia River chinook, fancy	1.65	1.75	1.05
Alaska pink	.70			Puget Sound sockeye	1.35	1.50	1.00
1906				Alaska red	1.15	1.35	.85
Columbia River chinook	1.50	1.60	1.00	Alaska king	1.10		
Puget Sound sockeye	1.45	1.60	1.00	Alaska coho	1.05	1.20	.70
Alaska red	.95			Alaska pink	.60		
Alaska pink	.75			Alaska chum	.57½		

American opening prices per dozen cans since 1890—Continued

Year and species	Talls	Flats	Halves
1910			
Columbia River chinook, fancy	$1.75	$1.90	$1.10
Puget Sound sockeye	1.65	1.80	1.10
Alaska red	1.35	1.50	1.00
Alaska king	1.35	------	------
Alaska pink	.80	------	------
Alaska chum	.77½	------	------
Medium red and coho	1.25	1.40	.80
1911			
Columbia River chinook, fancy	1.95	2.00	1.30
Puget Sound sockeye	1.95	2.00	1.30
Alaska red	1.60	1.75	1.12½
Alaska medium red	1.45	1.65	1.00
Alaska king	1.80	2.00	1.12½
Pink	1.00	1.15	.80
Chum	.95	1.05	.75
1912			
Chinook	1.95	2.00	1.25
Sockeye	1.95	2.00	1.30
Alaska red	1.40	1.60	1.15
Alaska medium red	1.15	1.25	.80
Alaska king	1.40	1.60	1.15
Pink	.65	.65	.55
Chum	.62½	------	.50
1913			
Chinook	1.95	2.00	1.25
Sockeye	1.50	1.65	1.05
Alaska red	1.15	1.35	.95
Alaska medium red	.85	1.00	.70
Alaska king	1.00	1.15	.90
Pink	.65	.80	.55
Chum	[1] .55	.70	.50
1914			
Chinook	1.95	2.10	1.25
Sockeye	1.95	2.15	1.35
Alaska red	1.45	1.80	1.10
Medium red	1.15	1.35	.82½
Alaska king	1.40	------	1.10
Pink	.90	1.00	.70
Keta, or chum	.85	.95	.65
1915			
Chinook	1.90	2.00	1.25
Sockeye	1.95	2.15	1.35
Alaska red	1.50	1.85	1.15
Medium red	1.15	1.30	.75
Alaska king	1.25	------	------
Pink	.75	.85	.57½
Keta, or chum	[2] .70	.80	.52½
1916 [3]			
Chinook	1.90	2.00	1.25
Sockeye	2.05	2.25	1.40
Alaska red	1.50	1.75	1.20
Medium red	1.30	1.45	.90
Alaska king	1.35	------	------
Pink	.90	1.10	.75
Chum	.85	------	.67½

Year and species	Talls	Flats	Halves
1917			
Chinook	$2.90	$3.00	$1.75
Sockeye	2.90	3.00	1.75
Alaska red	2.35	2.60	1.65
Medium red	2.00	2.15	1.35
Alaska king	2.25	------	------
Pink	1.65	1.80	1.15
Chum	1.60	1.75	------
1918 [4]			
Chinook:			
Fancy	3.15	3.25	2.00
Standard	2.75	2.85	1.75
Blueback	------	------	2.00
Sockeye	[5] 3.15	[5] 3.25	2.00
Alaska red	2.35	2.50	1.65
Medium red:			
Alaska	2.25	2.40	1.60
Puget Sound, etc.	2.40	2.50	1.60
Pink	1.65	1.80	1.15
Chum:			
Alaska	1.60	1.75	1.10
Puget Sound, etc.	1.75	1.85	1.10
Steelhead	3.00	3.10	1.90
1919			
Chinook	3.15	3.25	2.00
Sockeye	------	------	[6] 2.50
Alaska red	[7] 3.35	3.50	2.25
Tips and tails	3.10	------	------
Alaska king	[8] 3.12½	------	------
Medium red	3.00	3.15	2.00
Pink	2.25	2.40	1.40
Chum	[9] 2.15	2.30	1.25
1920			
Chinook:			
Fancy	3.90	4.00	2.50
Standard	3.15	3.25	1.95
Sockeye	------	------	3.00
Alaska red	3.25	3.40	2.25
Medium red	2.00	2.15	1.50
Alaska king	3.00	------	2.10
Pink	1.50	1.65	1.10
Chum	1.15	------	.90
1921			
Chinook, fancy	3.15	3.25	2.10
Sockeye	------	------	2.50
Alaska red	2.35	3.00	2.00
Medium red	1.50	1.65	.95
Alaska king	1.75	1.90	1.05
Pink	1.10	1.25	.80
Chum	1.00	------	.65
1922			
Chinook, fancy	3.40	3.50	3.25
Puget Sound sockeye	4.25	4.50	2.50
Alaska red	2.25	2.75	1.75
Medium red	1.25	1.60	1.00
Alaska king	1.75	2.00	1.75
Pink	1.15	1.25	.80
Chum	1.05	------	.70

[1] The opening price in San Francisco was 60 cents.
[2] The opening price in San Francisco was 65 cents.
[3] The Kelley-Clarke prices differed from these in the following particulars: Red talls, $1.60; red halves, $1.25; medium red talls, $1.35; medium red flats, $1.50; medium red halves, $1; pink talls, $1; chum talls, 95c.; and king talls, $1.40.
[4] Maximum prices set by U. S. Food Administration.
[5] Pack of 1-pound talls and 1-pound flats taken for British Government at these prices.
[6] No price named by Alaska Packers Association or Deming & Gould Co.
[7] Alaska Packers Association and Northwestern Fisheries Co. quoted $3.25; others reduced to conform.
[8] Quoted by Alaska Packers Association only.
[9] Alaska Packers Association quoted $2.10.

American opening prices per dozen cans since 1890—Continued

Year and species	Talls	Flats	Halves
1923			
Chinook:			
Fancy	$4.00	$4.00	$2.50
Standard	2.15	2.25	1.35
Puget Sound sockeye	-------	4.00	2.50
Alaska red	2.25	2.75	1.65
Alaska medium red	1.40	1.65	1.00
Puget Sound coho	1.50	1.70	1.05
Alaska king	2.00	2.25	1.50
Pink	1.25	1.35	.90
Chum	1.20	-------	.85
1924			
Chinook, fancy	3.55	3.60	2.20
Puget Sound sockeye	-------	3.50	2.25
Alaska red	2.25–2.50	2.50–2.75	1.50–1.75
Alaska medium red	1.50–1.75	1.65–2.00	1.05–1.35
Alaska king	2.10–2.15	2.40	1.50
Alaska pink	1.25–1.30	1.35	.90
Puget Sound pink	1.25–1.35	-------	-------
Chum	1.20	-------	.85
1925			
Chinook, fancy	3.50	3.60	2.10
Puget Sound sockeye	-------	3.75	2.35–2.50
Alaska red	3.50	3.75	2.25
King	3.00–3.25	3.50	2.00–2.15
Medium red or coho	2.50–2.75	2.75–2.90	1.75–1.85
Pink	1.25–1.45	1.35–1.50	1.00–1.10
Chum	1.10–1.15	-------	.85–.90

Year and species	Talls	Flats	Halves
1926			
Chinook, fancy	$3.95	$4.00	$2.35
Puget Sound sockeye	-------	4.00	2.50
Alaska red	2.50	3.15	2.00
King	2.25	3.00	1.75
Medium red or coho	2.25	2.50	1.50
Pink	1.35	1.50	1.05
Chum	1.25	-------	.80–.90
1927			
Chinook, fancy	3.95	4.00	2.35
Puget Sound sockeye	-------	4.00	2.75
Alaska red	3.10	3.25	2.15–2.25
King	2.65–2.85	3.00	1.90
Medium red or coho	2.25–2.50	2.50	1.55–1.0–
Pink	1.35–1.50	1.60	1.106 1.15
Chum	1.30–1.35	-------	.95
1928			
Chinook, fancy	4.15	4.20	2.45
Puget Sound sockeye	-------	4.50	2.60
Alaska red	2.35	3.00	1.85
King	2.00–2.15	2.40	1.80
Coho, fancy	1.85	2.15	1.35
Medium red	1.75–1.85	2.00	1.35
Pink	1.65	1.75	1.10
Chum	1.60	-------	1.00

BRITISH COLUMBIA OPENING PRICES

The packers of British Columbia and the United States both sell a considerable portion of their high-grade salmon abroad, and the competition thus engendered compels a fairly close conformity in prices. On salmon sold in the domestic markets, however, the competition is not so keen; hence there is room for a considerable diversity of opinion as to values. Unlike the United States, there is a very small market in Canada for chum salmon, and it has only been in recent years that opening prices have been fixed on this grade.

British Columbia opening prices since 1902 [1]

[Prices are for full cases]

Year and species	Talls	Flats	Halves
1902			
Sockeye	$4.75	$4.90	-------
Red spring	4.00	-------	-------
Coho	3.75	-------	-------
Pink	2.50	2.50	-------
1903			
Sockeye	4.65	-------	-------
Red spring	4.00	-------	-------
Coho	3.75	-------	-------
Pink	2.60	2.50	-------

Year and species	Talls	Flats	Halves
1904			
Sockeye	$5.75	$6.25	-------
Red spring	5.25	-------	-------
Coho	4.25	-------	-------
Pink	2.75	-------	-------
1905			
Sockeye	5.00	5.30	-------
Red spring	4.50	5.00	-------
Coho	4.00	-------	-------
Pink	2.60	-------	-------

[1] These opening prices have been furnished by H. Bell-Irving & Co. (Ltd.), of Vancouver, British Columbia, Canada, well-known packers and handlers of canned salmon.

British Columbia opening prices since 1902—Continued

[Prices are for full cases]

Year and species	Talls	Flats	Halves
1906			
Sockeye	$5.50		
Red spring	5.25		
Coho	4.50	$4.75	
Pink		3.00	
1907			
Sockeye	5.50		
Red spring	5.50	5.50	
Coho	4.50	4.50	
Pink	3.00	3.00	
1908			
Sockeye	6.10		
Red spring	5.75	5.75	
Coho	4.75	5.00	
Pink	3.25	3.25	
1909			
Sockeye	5.25		$6.75
Red spring	5.10	5.60	
Coho	4.25		
Pink	2.75		
1910			
Sockeye	6.50	7.00	8.25
Red spring	5.75	6.00	
Coho	5.00	5.50	6.50
Pink	3.25		
1911			
Sockeye	7.75	8.00	10.00
Red spring	6.50		
Coho	6.00	6.25	7.50
Pink	4.00	4.25	5.50
Chum	3.75		
1912			
Sockeye	9.00	9.25	10.75
Red spring	7.75		9.25
Coho	7.25	7.25	7.50
Pink	3.00	3.00	4.50
Chum	2.75		
1913			
Sockeye	6.00	6.25	7.75
Red spring	5.75	5.75	
Coho	4.25	4.50	
Pink	2.50	2.50	
1914			
Sockeye	7.50	8.75	9.25
Red spring	6.75		
Coho	4.75		5.50
Pink	3.50		
1915			
Sockeye	8.25	8.25	10.25
Red spring	6.75		
Coho	4.50	5.00	
Pink	3.25	3.50	4.75
Chum	2.75		
1916			
Sockeye	9.00		11.00
Red spring	8.00		9.50
Coho	6.50		9.00
Pink	3.75		5.25
Chum	3.00	4.00	
1917			
Sockeye	13.00		16.00
Red spring		12.00	13.00
Coho	10.00	11.00	12.50
Pink	8.00		9.25
Chum	6.65		
1918			
Sockeye	$14.50	$15.00	$16.00
Red spring	13.00	13.25	14.00
Coho	11.50	12.00	13.00
Pink	8.50	8.75	10.00
Chum	6.75		7.75
1919			
Sockeye	16.00	16.50	17.50
Red spring			16.00
Coho	12.00	12.50	13.50
Pink		9.00	10.00
Chum	6.75		
1920			
Sockeye	19.00	19.50	20.50
Red spring	16.50	16.75	18.00
Coho	12.00	12.25	13.50
Pink	6.50		7.50
Chum	5.25		6.25
1921			
Sockeye	17.00	17.25	18.00
Red spring	12.50	12.75	14.00
Coho	10.00	10.25	11.50
Pink	4.50		6.00
Chum	4.00		5.25
1922			
Sockeye	18.00	18.25	19.00
Red spring	13.00	13.25	14.00
Coho	8.00	8.25	9.00
Pink	5.00		6.75
Chum	4.50		6.00
1923			
Sockeye	13.00	13.50	14.00
Red spring	11.00		12.00
Coho	6.50	7.00	8.00
Pink	5.00	5.50	6.50
Chum	4.50	4.75	6.00
1924			
Sockeye	11.50	11.75	12.50
Red spring	10.00	10.50	11.00
Coho	6.50	6.75	8.00
Pink	5.00	5.25	6.00
Chum	4.50	4.75	5.50
1925			
Sockeye	15.00	15.50	16.00
Red spring	12.50	13.00	13.75
Coho	9.25	9.75	10.50
Pink	5.50	6.00	7.00
Chum	4.50	5.00	6.00
1926			
Sockeye	16.00	16.50	17.00
Red spring	14.00		15.50
Coho	12.00	12.50	13.00
Pink	5.75	6.25	7.75
Chum	4.75	5.25	6.50
1927			
Sockeye	16.00	16.50	17.00
Red spring	14.00	14.50	15.50
Coho	12.00	12.50	13.00
Pink	5.75	6.00	7.50
Chum	5.00	5.25	6.50
1928			
Sockeye	16.50	17.00	17.50
Red spring, fancy	13.50		14.50
Coho	12.00	12.50	13.00
Pink	6.00	6.50	7.50
Chum	5.25	5.75	6.50

PICKLING INDUSTRY

The salmon-pickling industry was so overshadowed by its giant brother, the canning industry, that statistical data, except for Alaska, were found in extremely fragmentary shape, and only that portion is shown relating to Alaska from the time of annexation to and including 1928.

Pack of salted salmon in Alaska, 1868 to 1928

Year	Salmon		Salmon bellies		Dry-salted salmon	
	Barrels	Value	Barrels	Value	Pounds	Value
1868	2,000	$16,000				
1869	1,700	13,600				
1870	1,800	14,400				
1871	700	6,300				
1872	1,000	9,000				
1873	900	7,200				
1874	1,400	11,200				
1875	1,200	9,600				
1876	1,800	14,400				
1877	1,950	15,700				
1878	2,100	16,800				
1879	3,500	28,000				
1880	3,700	29,600	300	$3,300		
1881	1,760	15,840				
1882	5,890	53,010				
1883	7,251	65,259				
1884	6,106	54,954				
1885	3,230	29,070				
1886	4,861	43,749				
1887	3,978	35,802				
1888	9,500	85,500				
1889	6,457	58,013				
1890	18,039	162,351				
1891	8,913	71,304				
1892	17,374	140,057	53	815		
1893	24,005	120,083				
1894	32,011	176,060				
1895	14,234	85,404				
1896	9,314	65,198	150	1,200		
1897	15,848	110,936	2,846	28,460		
1898	22,670	181,360	580	5,800		
1899	22,382	167,865	235	2,350		
1900	31,852	238,890	2,353	23,530	511,400	$10,228
1901	24,477	171,339	652	3,816		
1902	30,384	212,688	328	2,952		
1903	27,921	223,368	3,667	32,973	300,000	5,500
1904	13,674	89,209	208	1,950	966,812	16,180
1905	19,071	143,811	1,360	11,355	7,280,234	115,643
1906	17,283	126,194	1,338	13,644	1,107,680	16,969
1907	22,307	203,127	2,965	37,422	107,580	1,505
1908	34,337	293,377	4,736	59,330	20,800	416
1909	28,915	183,400	1,970	25,358	71,600	1,038
1910	12,779	111,634	1,626	19,007	22,178	554
1911	8,483	102,477	1,337	15,561	33,285	1,340
1912	34,602	305,928	37	606		
1913	37,881	272,726	451	6,523	21,282	1,235
1914	25,954	247,195	408	5,467	12,200	810
1915	12,058	157,457	571	13,610		
1916	17,259	205,706	475	6,961	44,552	2,408
1917	36,165	584,962	225	5,535	371,600	33,044
1918	56,837	1,078,456	53	1,425	516,975	47,544
1919	8,110	195,447			212,244	17,601
1920	4,800	104,213	22	660	224,840	37,535
1921	9,977	176,789	105	2,625		
1922	17,742	277,607	184	6,408	79,400	940
1923	11,596	184,546	68	2,244		
1924	6,518	119,223	297	13,000	6,400	206
1925	2,935	70,346	213	14,385	5,200	582
1926	7,593	163,230	475	10,450	75,018	7,263
1927	3,668	86,480	164	6,232	21,400	2,011
1928	4,283	108,562	3	75	21,800	1,900
Total	827,034	8,352,002	30,455	385,029	12,034,480	322,452

NOTE.—The statistics on salmon bellies for the years 1920 to 1928, inclusive, were taken from Pacific Fisherman.

Alaska pickled-salmon pack, 1906 to 1918, by species, quantity,[1] and value

Species	1906		1907		1908		1909		1910	
	Barrels	Value	Barrels	Value	Barrels	Value	Barrels	Value	Barrels	Value
Whole salmon:										
Coho	539	$5, 642	1, 665	$16, 406	692	$5, 648	318	$2, 485	160	$1, 504
Chum	231	1, 550	233	1, 521	122	707	35	190		
Humpback	2, 446	13, 852	4, 248	29, 374	2, 346	17, 935	1, 557	9, 405	330	1, 998
King	1, 007	8, 058	964	10, 684	660	6, 813	441	3, 798	352	3, 399
Red	13, 060	97, 092	15, 197	145, 142	30, 517	262, 274	26, 508	167, 298	11, 931	104, 649
Total	17, 283	126, 194	22, 307	203, 127	34, 337	293, 377	28, 859	183, 176	12, 773	111, 550
Bellies:										
Coho			191	2, 696	229	3, 535	255	3, 843	126	1, 135
Chum	30	150			117	699			70	770
Humpback	1, 273	13, 188	1, 800	21, 080	2, 447	28, 140	738	7, 438	616	6, 135
King	22	185	84	1, 002	48	720	35	175	6	128
Red	13	121	890	12, 644	1, 895	26, 236	942	13, 902	808	10, 839
Total	1, 338	13, 644	2, 965	37, 422	4, 736	59, 330	1, 970	25, 358	1, 626	19, 007
Backs, etc.:										
Humpback							56	224		
King									2	24
Red									4	60
Total							56	224	6	84
Grand total	18, 621	139, 838	25, 272	240, 549	39, 073	352, 707	30, 885	208, 758	14, 405	130, 641

Species	1911		1912		1913		1914	
	Barrels	Value	Barrels	Value	Barrels	Value	Barrels	Value
Whole salmon:								
Coho	223	$2, 149	1, 165	$9, 565	1, 006	$6, 452	365	$2, 767
Chum	133	666	93	652	100	778	53	293
Humpback	1, 122	11, 238	4, 236	28, 304	2, 724	18, 181	482	2, 954
King	600	8, 095	225	2, 442	135	1, 410	269	2, 588
Red	6, 239	79, 578	28, 883	264, 965	33, 916	245, 905	24, 785	238, 593
Total	8, 317	101, 726	34, 602	305, 928	37, 881	272, 726	25, 954	247, 195
Bellies:								
Coho	38	489			54	946	67	982
Chum	7	77			67	941	18	180
Humpback	676	5, 122	37	606	324	4, 546	229	2, 620
King	2	30					2	13
Red	614	9, 843			6	90	92	1, 672
Total	1, 337	15, 561	37	606	451	6, 523	408	5, 467
Backs, etc.:								
Humpback	150	600						
King	1	15						
Red	15	136						
Total	166	751						
Grand total	9, 820	118, 038	34, 639	306, 534	38, 332	279, 249	26, 362	252, 662

[1] Barrels hold 200 pounds of fish; when of a different size they have been reduced to conform to this weight.

Alaska pickled-salmon pack, 1906 to 1918, by species, quality, and value—Contd.

Species	1915		1916		1917		1918	
	Barrels	Value	Barrels	Value	Barrels	Value	Barrels	Value
Whole salmon:								
Coho	1,763	$19,393	2,076	$22,287	1,798	$29,631	2,501	$47,152
Chum	325	2,925	495	4,057	1,722	21,899	6,080	84,878
Humpback	662	5,958	503	3,624	5,576	73,857	11,973	182,490
King	377	4,147	636	7,956	359	6,556	297	7,645
Red	8,931	125,034	13,549	167,782	26,710	453,019	35,977	756,191
Total	12,058	157,457	17,259	205,706	36,165	584,962	56,828	1,078,356
Bellies:								
Coho			27	500	11	326	10	180
Chum			285	3,556	73	1,362		
Humpback	133	2,660	61	882	110	2,885	26	650
King			2	23	7	150		
Red	438	10,950	100	2,000	24	812	17	595
Total	571	13,610	475	6,961	225	5,535	53	1,425
Backs, etc: Coho							9	100
Grand total	12,629	171,067	17,734	212,667	36,390	590,497	56,890	1,079,881

Alaska pickled-salmon pack, 1919 to 1928, by species and districts

Year and species	Southeast Alaska		Central Alaska		Western Alaska		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1919								
Coho or silver	141,200	$13,206	40,800	$3,024	58,400	$5,918	240,400	$22,148
Chum or keta	14,000	2,080	5,400	135	8,200	555	27,600	2,770
Humpback or pink	5,200	260	10,000	700	9,000	548	24,200	1,508
King or spring	48,200	4,542	1,600	232	123,600	16,267	173,400	21,041
Red or sockeye	2,400	355	117,400	12,380	1,036,600	135,245	1,156,400	147,980
Total	211,000	20,443	175,200	16,471	1,235,800	158,533	1,622,000	195,447
1920								
Coho or silver	22,000	2,160	36,600	3,880	21,800	2,090	80,400	8,130
Chum or keta	21,000	1,400			23,800	2,360	44,800	3,760
Humpback or pink	12,200	882			27,000	1,400	39,200	2,282
King or spring	20,000	2,000	1,600	160	28,800	3,201	50,400	5,361
Red or sockeye	32,800	3,280	1,200	150	715,600	81,910	749,600	85,340
Total	108,000	9,722	39,400	4,190	817,000	90,961	964,400	104,873
1921								
Coho or silver	23,000	1,624	16,600	1,120	1,600	120	41,200	2,864
Chum or keta	36,600	1,443	1,000	50	20,600	1,558	58,200	3,051
Humpback or pink	75,600	3,062	6,000	355			81,600	3,417
King or spring			51,200	5,120	43,400	5,487	94,600	10,607
Red or sockeye	97,200	9,574	114,200	10,654	1,529,400	139,247	1,740,800	159,475
Total	232,400	15,703	189,000	17,299	1,595,000	146,412	2,016,400	179,414
1922								
Coho or silver	149,800	10,915	4,200	285	13,400	914	167,400	12,114
Chum or keta			6,200	600	11,000	901	17,200	1,501
Humpback or pink			33,100	1,660			33,100	1,660
King or spring	200	10	7,100	748	63,900	5,754	71,200	6,512
Red or sockeye			291,600	27,753	3,004,600	234,475	3,296,200	262,228
Total	150,000	10,925	342,200	31,046	3,092,900	242,044	3,585,100	284,015

Alaska pickled-salmon pack, 1919 to 1928, by species and districts—Continued

Year and species	Southeast Alaska		Central Alaska		Western Alaska		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1923								
Coho or silver	33,000	$2,200	38,644	$2,080			71,644	$4,280
Chum or keta	1,500	120	6,000	900	5,200	$270	12,700	1,290
Humpback or pink	5,000	400	3,000	150			8,000	550
King or spring	3,000	240	4,800	411	64,000	10,656	71,800	11,307
Red or sockeye			62,300	6,390	2,106,400	162,973	2,168,700	169,363
Total	42,500	2,960	114,744	9,931	2,175,600	173,899	2,332,844	186,790
1924								
Coho or silver	18,300	1,129	34,668	5,118			52,968	6,247
Chum or keta	600	27	644	75	60,600	3,580	61,844	3,682
Humpback or pink	6,000	268	257,540	15,399			263,540	15,667
King or spring	400	40			101,100	12,937	101,500	12,977
Red or sockeye	15,400	1,723	4,100	500	863,600	91,427	883,100	93,650
Total	40,700	3,187	296,952	21,092	1,025,300	107,944	1,362,952	132,223
1925								
Coho or silver	80,500	7,853	87,250	9,636	5,600	630	173,350	18,119
Chum or keta	4,200	420	9,400	1,025	12,300	1,100	25,900	2,545
Humpback or pink	8,200	686	30,250	3,255			38,450	3,941
King or spring	1,800	144	500	62	121,000	18,046	123,300	18,252
Red or sockeye	200	27	101,800	10,787	166,600	31,060	268,600	41,874
Total	94,900	9,130	229,200	24,765	305,500	50,836	629,600	84,731
1926								
Coho or silver	24,000	2,300	48,100	8,882	11,200	1,044	83,300	12,226
Chum or keta			48,500	5,062	34,700	2,616	83,200	7,678
Humpback or pink	32,800	2,040	90,900	7,160	6,600	462	130,300	9,662
King or spring			5,800	596	49,400	6,157	55,200	6,753
Red or sockeye			267,200	23,732	994,400	113,629	1,261,600	137,361
Total	56,800	4,340	460,500	45,432	1,096,300	123,908	1,613,600	173,680
1927								
Coho or silver	17,600	1,800	95,200	8,934	10,000	950	122,800	11,684
Chum or keta			1,000	100	16,100	1,623	17,100	1,723
Humpback or pink	1,800	100	18,700	1,419			20,500	1,519
King or spring			11,700	1,109	24,000	3,246	35,700	4,355
Red or sockeye	13,600	1,700	66,800	8,680	489,900	63,051	570,300	73,431
Total	33,000	3,600	193,400	20,242	540,000	68,870	766,400	92,712
1928								
Coho or silver	21,200	2,092	38,400	3,403	9,800	735	69,400	6,230
Chum or keta					15,300	1,458	15,300	1,458
Humpback or pink	5,000	258	200	15	3,400	229	8,600	502
King or spring	200	40	300	43	29,200	4,091	29,700	4,174
Red or sockeye	1,400	195	53,700	2,466	679,000	93,612	734,100	96,273
Total	27,800	2,585	92,600	5,927	736,700	100,125	857,100	108,637

MILD-CURING INDUSTRY

The beginning of this industry on the Pacific coast is of comparatively recent date, and the following table is complete, with the possible exception of a few tierces, which may not have been reported for the coastal rivers of Oregon:

Tierces of mild-cured salmon packed on Pacific coast from 1897 to 1928 [1]

Year	Alaska	British Columbia	Puget Sound, Wash.	Grays Harbor, Wash.	Willapa Harbor, Wash.	Columbia River (both sides)	Coastal rivers, Oreg.	Klamath, Noyo, and Eel Rivers, Calif.	Sacramento River, Calif.	Monterey Bay, Calif.	Total
1897						400					400
1898	70					700					770
1899	130			375		1, 250					1, 755
1900						1, 275			950		2, 225
1901	67		600			3, 000			3, 100		6, 767
1902	67		425			4, 213	188		2, 325	504	7, 722
1903	8		824			6, 725			3, 600	354	11, 511
1904	34		1, 250			9, 088		200	4, 719	248	15, 539
1905	189	1, 175	3, 000			9, 805	415		2, 979	310	17, 873
1906	1, 126	957				8, 000	740	175	2, 177	510	13, 685
1907	1, 657	1, 993	2, 060	20	100	6, 070	740	140	4, 102	582	17, 464
1908	1, 378	1, 060				4, 960			3, 243	252	10, 893
1909	2, 292	1, 560	2, 109	75	29	5, 540	560	80	5, 111	911	18, 267
1910	3, 357	1, 638	2, 435	67		7, 922	1, 398		5, 516	75	22, 408
1911	3, 164	1, 965	2, 745	100	30	8, 185	1, 247	110	2, 011	160	19, 717
1912	5, 245	1, 489	3, 013	357	40	5, 824	3, 082	100	3, 274		22, 424
1913	7, 443	3, 150	3, 923	250	50	5, 746	2, 381		4, 789	550	28, 282
1914	4, 091	3, 182	1, 934			5, 205	457		1, 829	1, 476	18, 174
1915	2, 966	1, 119	2, 235			4, 078	333	3	1, 630	942	13, 306
1916	4, 898	1, 848	1, 755			4, 656	194		650	1, 069	15, 070
1917	3, 563	429	1, 063			1, 886			1, 508	300	8, 749
1918	3, 948	729	1, 093			1, 804	275	455	1, 913	266	10, 483
1919	5, 376	1, 173	2, 423			3, 328	148	1, 326	2, 355	1, 055	17, 184
1920	2, 295	1, 116	2, 036			2, 275	102	1, 463	1, 345	330	10, 962
1921	3, 556	1, 076	4, 517	90		3, 051	70	1, 050	812	201	14, 423
1922	5, 283	2, 253	4, 727			1, 621	162	550	1, 195		15, 791
1923	4, 219	1, 819	5, 799			1, 769	176	1, 126	606	103	15, 617
1924	6, 484	2, 969	6, 409			2, 320	286	2, 619	1, 291	5	22, 383
1925	6, 522	3, 098	5, 600			2, 746	547	1, 965	1, 523	276	22, 277
1926	5, 712	2, 183	4, 087			1, 055	1, 205	929	1, 767		16, 938
1927	8, 804	2, 689	5, 160			951	918	895	1, 125	32	20, 574
1928	5, 850	2, 676	4, 304	89		1, 175	1, 924	1, 686	179		17, 883
Total	99, 794	43, 346	75, 526	1, 423	249	126, 623	17, 548	14, 872	67, 624	10, 511	457, 516

[1] The net weight of fish in a tierce is about 800 pounds. King, chinook, or spring salmon were used almost exclusively. From most places the data are complete from the time of the inception of the industry but from a few minor places the data are somewhat fragmentary.

YUKON TERRITORY, CANADA

Some salmon fishing is carried on in that section of the upper Yukon River which lies in Yukon Territory, Dominion of Canada. The species taken are principally king and chum, and these are sold mainly in a fresh condition. The following table shows the quantity taken and the value of same in certain years:

Catch of salmon in Yukon Territory, Canada, in specified years

Year	Salmon		Year	Salmon	
	Pounds	Value		Pounds	Value
1903	70, 000	$5, 600	1914	188, 600	$18, 860
1909	138, 574	17, 566	1915	157, 000	15, 700
1910	169, 900	18, 689	1916	143, 500	14, 350
1911	229, 000	22, 900	1917		
1912	224, 100	22, 410	1918		
1913	182, 000	18, 200	1919		

TRADE WITH OUTLYING POSSESSIONS

As a result of the war with Spain the United States in 1898 acquired possession of Porto Rico, Guam, and the Philippine Islands, while in the same year Hawaii became a part of this country at its own request. In 1900 two islands of the Samoan group were acquired by a partition agreement with Great Britain and Germany, and in 1917 the Virgin Islands were purchased from Denmark. The trade with the Philippine Islands and the Virgin Islands is shown to date in the tables of exports and imports to foreign countries, but the trade with the other possessions has been eliminated from these tables and shown separately ever since their annexation to the United States.

HAWAII

The islands constituting this Territory, owing to their reciprocity treaty with this country for a number of years before annexation, purchased their supplies of salmon from the United States almost exclusively. In recent years the Territory has imported the following quantities of salmon from the mainland:

Year	Canned salmon		All other salmon, fresh or cured	Year	Canned salmon		All other salmon, fresh or cured
	Pounds	Value	Value		Pounds	Value	Value
1907	1,126,217	$89,286	$64,232	1918 [2]	758,022	$108,771	(1)
1908	965,029	89,025	67,143	1919	633,391	129,851	(1)
1909	1,440,410	121,716	73,848	1920	1,657,663	296,863	(1)
1910	1,381,398	113,526	72,194	1921	1,129,847	202,236	(1)
1911	1,231,264	119,872	76,572	1922	1,150,358	135,301	(1)
1912	1,850,567	194,385	57,495	1923	1,385,146	219,849	(1)
1913	1,841,874	173,202	(1)	1924	1,565,036	232,961	(1)
1914	1,418,941	97,532	(1)	1925	2,033,553	267,985	(1)
1915	1,005,848	90,705	(1)	1926	892,212	149,961	(1)
1916	1,582,528	132,597	(1)	1927	1,026,536	195,518	(1)
1917	1,463,729	145,531	(1)	1928	1,269,029	222,425	(1)
1918	1,168,528	174,777	(1)				

[1] Not shown separately.
[2] Compilation of trade statistics changed from fiscal year to calendar year basis in 1918.

PORTO RICO

Of recent years the following shipments of domestic salmon have been made to this island:

Year	Canned salmon		All other salmon, fresh or cured	Year	Canned salmon		All other salmon, fresh or cured
	Pounds	Value	Value		Pounds	Value	Value
1907	604,627	$53,916	$2,893	1918 [2]	531,325	$75,096	(1)
1908	512,038	48,195	1,428	1919	331,635	48,673	(1)
1909	381,171	34,777	3,810	1920	1,063,633	126,109	(1)
1910	511,055	43,494	6,243	1921	720,073	57,577	(1)
1911	357,382	30,699	3,868	1922	802,558	72,736	(1)
1912	710,721	65,354	1,208	1923	604,296	58,627	(1)
1913	666,602	66,811	(1)	1924	1,221,828	127,035	(1)
1914	416,414	41,726	(1)	1925	746,957	75,999	(1)
1915	588,889	56,527	(1)	1926	865,767	80,037	(1)
1916	860,873	60,453	(1)	1927	641,177	68,517	(1)
1917	881,360	70,427	(1)	1928	344,187	60,012	(1)
1918	378,266	52,737	(1)				

[1] Not shown separately.
[2] Compilation of trade statistics changed from fiscal year to calendar year basis in 1918.

PHILIPPINE ISLANDS

Of recent years the following shipments of domestic salmon have been made to these islands:

Year	Canned salmon		All other salmon, fresh or cured	Year	Canned salmon		All other salmon, fresh or cured
	Pounds	Value			Pounds	Value	
			Value				*Value*
1909	1, 126, 470	$74, 792	$712	1919	2, 371, 736	$279, 408	(1)
1910	5, 425, 404	396, 604	2, 089	1920	8, 616, 832	902, 202	(1)
1911	3, 069, 118	225, 885	3, 542	1921	4, 271, 892	313, 280	(1)
1912	5, 096, 810	422, 001	2, 437	1922	7, 719, 124	610, 114	$3, 279
1913	10, 122, 820	590, 128	(1)	1923	7, 055, 041	667, 713	2, 675
1914	5, 034, 252	266, 369	(1)	1924	7, 884, 986	793, 939	6, 481
1915	4, 159, 580	288, 548	(1)	1925	7, 533, 837	709, 599	2, 605
1916	5, 640, 858	356, 366	(1)	1926	8, 140, 977	824, 512	1, 462
1917	4, 202, 574	351, 633	(1)	1927	4, 742, 208	499, 526	2, 270
1918	5, 558, 796	618, 697	(1)	1928	258, 357	33, 046	3, 466
1918 [2]	5, 291, 182	579, 410	(1)				

[1] Not shown separately.
[2] Compilation of trade statistics changed from fiscal year to calendar year basis in 1918.

VIRGIN ISLANDS

Of recent years the following shipments of domestic salmon have been made to these islands:

Year	Canned salmon		All other salmon, fresh or cured	Year	Canned salmon		All other salmon, fresh or cured
	Pounds	Value			Pounds	Value	
			Value				*Value*
1918	20, 059	$4, 221	$257	1923	30, 454	$3, 829	$323
1919	22, 498	4, 447	695	1924	37, 989	4, 496	495
1920	56, 124	10, 441	1, 729	1925	48, 475	5, 883	498
1921	57, 316	7, 637	1, 790	1926	42, 777	5, 201	376
1922	42, 014	5, 178	412	1927	42, 754	5, 313	427

ALASKA

It seems like "carrying coals to Newcastle" to ship canned salmon to Alaska, from which Territory more than half the canned salmon of the world is produced, and yet a small business is done each year in this line, most of the product going to the mining camps and towns somewhat removed from the fishing sections.

The table below shows the shipments of such fish in certain years. After 1914 the shipments were lumped together with all other kinds of fish and thus prevented the listing of salmon separately.

Year	Canned salmon		All other salmon, fresh or cured	Year	Canned salmon		All other salmon, fresh or cured
	Pounds	Value			Pounds	Value	
			Value				*Value*
1909	67, 132	$7, 123	$3, 966	1912	134, 320	$15, 022	$4, 218
1910	67, 658	7, 204	3, 558	1913	43, 346	5, 074	(1)
1911	38, 265	4, 513	1, 061	1914	42, 945	5, 278	(1)

[1] Not shown separately.

GUAM

Since annexation, this country and Japan have been competing for the trade of this island, which, in earlier years, Japan controlled quite largely. During the last two years shown in the statement, however, the United States has secured the advantage. The table below shows the extent of the trade, which is made up almost entirely of salted or pickled salmon, only 900 pounds of fresh salmon, valued at $92, having been shipped by this country to Guam in 1908. Since 1909 all the fishery products imported have been lumped under one heading and it has been impossible to distinguish the salmon from the other species.

Year and country	Pickled salmon		Year and country	Pickled salmon	
	Pounds	Value		Pounds	Value
1905			1908		
United States	1,415	$71	United States	7,406	$623
Japan	16,526	1,221	Japan	6,130	465
1907			1909		
United States	13,604	1,086	United States	10,779	740
Japan	19,862	1,601	Japan	4,295	344

TUTUILA, SAMOA

The customs statistics lump the imports of fish under one general heading, thus making it impossible to show separately the imports of salmon.

FOREIGN TRADE IN SALMON

As we do not consume all of the salmon produced by our fisheries, it is necessary to find a foreign market for the surplus each season, but, as canned salmon has become one of the staples of the world, there is not much difficulty in this respect, especially since our only competitors are Canada, Siberia, and Japan. There is more competition in the pickled, fresh, and frozen markets, several European and Asiatic countries being large producers of these goods, as is Canada also, for a considerable proportion of which she is compelled to find an outside market.

The World War greatly disturbed the usual course of our foreign trade. Because of the need for foodstuffs a tremendous demand arose in Europe for our salmon, resulting in a decided increase in the quantities shipped there and, for a while, in a reduction of our exports in other directions. In time, however, the markets adjusted themselves to the changed conditions of trade.

EXPORTS OF DOMESTIC CANNED SALMON

From the beginning of the industry a considerable proportion of the salmon canned has been exported, especially of the higher grades. In Europe the chief customer is Great Britain, although Belgium, Netherlands, and Greece are good customers. Great Britain does not, however, consume this quantity, for a considerable part of her importations are reexported. On the North American Continent and adjacent islands the best customers are Mexico, Cuba, Panama, and the British West Indies. The heavy shipments to Canada are mainly transit shipments to Europe by Canadian steamship lines. In South America, Chile, Peru, Argentina, Colombia, and Venezuela are the leading markets. In Asia, Hong Kong and China import canned salmon, although neither buys great quantities. The islands of the Pacific and Indian Oceans are large consumers. British Australasia, British East Indies, and British, French, and German Oceania are good customers. In Africa the British and Portuguese possessions are the largest importers.

The movements of these products are naturally often influenced favorably or adversely as the tariffs of the various countries in which they are marketed are raised or lowered.

Some countries maintain excessively high tariffs on canned salmon, among these being Argentina, 29.06 cents per pound; Brazil, 21.62 cents; Cuba, 6.80 cents; New Zealand, 6.09 cents; Mexico, 5.67 cents; Peru, 5.52 cents; Chile, 5.48 cents; and Australia, 5.08 cents.

In but few of the tariff acts is canned salmon distinguished by name, being usually classed as "preserved fish," and as these are usually luxuries in many countries they bear an extra high duty as a result.

In addition to these high duties in some countries, especially in South America, there are various other charges, fees, etc., which materially enhance the value of the goods before they reach the consumer. C. H. Clarke, of the salmon brokerage firm of Kelley-Clarke Co., of Seattle, Wash., prepared and published a statement [40] showing the comparative charges on 100 cases each of red Alaska and pink canned salmon from the time they leave Seattle up to the time they reach the hands of wholesalers in South America. This shows that the f. o. b. Seattle value of the red salmon was $500 and of the pink salmon $280. By the time these goods reached the hands of the Rio de Janeiro wholesalers the red salmon were worth $1,900.07, while the pink salmon were worth $1,677.87. At Montevideo, Uruguay, the red salmon were worth $1,436.01 and the pink salmon $1,213.81. The table is so interesting and instructive that it is reproduced entire herewith.

Comparative charges on 100 cases each of red Alaska and pink canned salmon from Seattle, Wash., to hands of wholesalers in South America

	Argentina (Buenos Aires)		Brazil (Rio de Janeiro)		Chile (Valparaiso)		Ecuador (Guayaquil)	
	Red	Pink	Red	Pink	Red	Pink	Red	Pink
F. o. b. Seattle value	$500.00	$280.00	$500.00	$280.00	$500.00	$280.00	$500.00	$280.00
Strapping	5.00	5.00	5.00	5.00	--------	--------	--------	--------
Freight	104.75	104.75	114.50	114.50	45.00	45.00	45.00	45.00
Marine insurance, 5 per cent f. p. a.	6.10	3.90	6.20	4.00	5.50	3.25	5.50	3.25
C. i. f. value	615.85	393.65	625.70	403.50	550.50	328.25	550.50	328.25
Consular fees in United States	2.00	2.00	3.25	3.25	5.25	4.25	22.35	14.00
Customs duty	519.56	519.56	1,138.78	1,138.78	160.46	160.46	345.37	234.37
Analysis	2.12	2.12	6.47	6.47	--------	--------	--------	--------
Storage in customhouse	2.41	2.41	33.90	33.90	5.35	5.35	--------	--------
Handling in customhouse	7.24	7.24	--------	--------	2.51	2.51	--------	--------
Stamps and entry blanks	1.49	1.49	--------	--------	1.43	1.43	--------	--------
Statistics	--------	--------	.10	.10	--------	--------	--------	--------
Internal-revenue tax	--------	--------	7.77	7.77	--------	--------	--------	--------
Port tax	--------	--------	57.20	57.20	--------	--------	--------	--------
Customs brokerage	12.74	12.74	--------	--------	7.15	7.15	--------	--------
Wharfage, lighterage, cartage	7.64	7.64	26.90	26.90	3.65	3.65	19.30	19.30
Value ex customhouse	1,171.05	948.85	1,900.07	1,677.87	736.30	513.05	937.52	706.92

[40] Pacific Fisherman, Vol. 13, No. 5, p. 11, 1915.

Comparative charges on 100 cases each of red Alaska and pink canned salmon from Seattle, Wash., to hands of wholesalers in South America—Continued

	Paraguay (Asuncion)		Peru (Callao)		Uruguay (Montevideo)		Venezuela (La Guayra)	
	Red	Pink	Red	Pink	Red	Pink	Red	Pink
F. o. b. Seattle value	$500.00	$280.00	$500.00	$280.00	$500.00	$280.00	$500.00	$280.00
Strapping	5.00	5.00			5.00	5.00	5.00	5.00
Freight	134.75	134.75	37.50	37.50	104.75	104.75	54.60	54.60
Marine insurance, 5 per cent f. p. a.	9.60	6.30	5.40	3.20	6.10	3.90	5.60	3.40
C. i. f. value	649.35	426.05	542.90	320.70	615.85	393.65	565.20	343.00
Consular fees in United States	2.00	2.00	5.75	3.45	1.05	1.05	12.85	12.85
Customs duty	308.25	308.25	275.86	275.86	779.30	779.30	238.96	238.06
Analysis								
Storage in customhouse								
Handling in customhouse					16.15	16.15		
Stamps and entry blanks			.58	.58	1.55	1.55	1.35	.97
Statistics	.37	.37						
Internal-revenue tax								
Port tax								
Customs brokerage			4.86	4.86	15.50	15.50	5.00	2.80
Wharfage, lighterage, cartage	6.33	6.33	15.69	15.69	6.61	6.61	12.82	12.82
Value ex customhouse	966.30	743.00	845.64	621.14	1,436.01	1,213.81	836.18	611.40

The following table shows in summarized form the yearly exports of domestic canned salmon and the countries to which exported for the years 1900 to 1915, inclusive, and in detailed form for the years 1916 to 1927, inclusive:

Exports, by countries receiving, of domestic canned salmon

SUMMARY, 1900–1915 [1]

Country receiving	1900		1901		1902		1903	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Europe	18,941,109	$1,881,725	31,877,663	$3,234,862	30,683,551	$2,625,284	35,410,768	$3,125,197
North America	1,051,808	98,064	2,443,561	297,440	2,780,844	242,029	4,285,406	378,655
South America	1,868,225	192,918	1,577,013	160,862	1,291,998	107,907	1,756,214	121,918
Asia	654,126	67,941	853,434	86,571	1,597,346	120,674	1,759,294	134,783
Oceania	3,882,646	390,466	3,681,276	367,533	8,179,161	670,741	5,511,514	444,505
Africa	684,456	62,534	856,553	83,003	2,640,214	224,767	1,630,138	145,733

Country receiving	1904		1905		1906	
	Pounds	Value	Pounds	Value	Pounds	Value
Europe	33,591,896	$3,508,818	21,071,263	$1,877,509	32,061,402	$2,753,643
North America	2,446,023	204,363	1,565,773	132,134	2,069,357	171,946
South America	2,055,859	147,333	1,708,828	134,941	3,499,603	249,052
Asia	12,995,768	930,054	3,994,862	280,704	779,415	60,173
Oceania	3,898,606	341,849	5,257,446	467,928	6,340,346	509,257
Africa	936,126	92,181	1,468,383	142,253	1,194,291	103,872

Country receiving	1907		1908		1909	
	Pounds	Value	Pounds	Value	Pounds	Value
Europe	7,756,780	$791,436	13,321,086	$1,205,375	23,028,476	$2,207,194
North America	3,052,658	261,138	2,654,175	242,879	2,209,405	198,043
South America	5,659,690	414,774	5,571,000	410,743	1,461,662	123,502
Asia	1,419,391	105,364	1,004,571	86,908	1,386,702	119,582
Oceania	6,719,157	552,205	5,131,554	439,917	7,383,494	705,204
Africa	610,429	58,132	543,659	52,696	647,370	62,911

[1] Detailed statistics for 1900 to 1915, inclusive, may be found in Pacific Salmon Fisheries, by John N. Cobb, Appendix III, Report, U. S. Commissioner of Fisheries, 1916, pp. 187–194. Washington, 1917.

Exports, by countries receiving, of domestic canned salmon—Continued

Country receiving	1910		1911		1912	
	Pounds	Value	Pounds	Value	Pounds	Value
Europe	44, 765, 898	$4, 712, 182	22, 134, 328	$2, 408, 708	19, 545, 720	$2, 183, 982
North America	2, 224, 516	191, 551	1, 979, 950	190, 637	3, 411, 176	332, 692
South America	3, 193, 812	226, 197	3, 006, 927	266, 903	6, 756, 440	609, 383
Asia	1, 596, 775	133, 516	1, 489, 282	148, 721	1, 702, 426	160, 119
Oceania	11, 568, 824	998, 219	9, 699, 624	991, 540	11, 220, 515	1, 255, 149
Africa	510, 871	52, 593	290, 688	30, 633	787, 479	79, 238

Country receiving	1913		1914		1915	
	Pounds	Value	Pounds	Value	Pounds	Value
Europe	25, 408, 154	$2, 705, 254	62, 862, 328	$6, 026, 170	63, 760, 758	$7, 110, 728
North America	4, 271, 710	370, 823	6, 907, 615	511, 545	4, 328, 246	370, 444
South America	4, 134, 771	292, 367	3, 472, 438	233, 675	1, 301, 962	107, 783
Asia	3, 593, 538	254, 209	2, 875, 995	180, 402	1, 135, 793	97, 662
Oceania	17, 419, 390	1, 441, 270	12, 089, 003	1, 017, 994	12, 100, 414	1, 309, 376
Africa	463, 403	39, 417	353, 541	29, 507	818, 943	76, 450

DETAILS, 1916 TO 1918 [2]

Country receiving	1916		1917		1918	
	Pounds	Value	Pounds	Value	Pounds	Value
EUROPE						
Belgium			1, 115, 792	$8, 546	18, 000	$2, 525
Denmark	366, 948	$29, 255	89, 405	9, 650		
France	3, 447, 022	377, 597	985, 582	153, 927	7, 937, 490	1, 167, 737
Gibraltar					1, 156, 864	167, 157
Greece	70, 560	6, 059	190, 736	14, 486	173, 400	24, 935
Iceland, and Faroe Islands	136	16	2, 820	297	96	16
Italy	34, 184	3, 170	4, 169, 250	436, 576	13, 540, 046	1, 752, 163
Malta, Gozo, etc	9, 120	702	5, 520	525		
Netherlands	21, 868	2, 865	20, 450	2, 709		
Norway	41, 280	4, 383	54, 440	6, 164		
Portugal	20	2	60	7	794	178
Russia in Europe			240	18		
Serbia and Montenegro	170	17				
Spain	4, 995	382	37, 481	3, 369	1, 315	274
Sweden	60, 122	6, 666	14, 100	1, 800		
United Kingdom:						
England	109, 039, 707	11, 105, 506	74, 941, 169	8, 536, 248	46, 415, 026	7, 447, 389
Scotland	1, 067, 530	111, 381	1, 131, 832	139, 718	848, 295	129, 652
Ireland					900	220
NORTH AMERICA						
Bermuda	89, 599	8, 741	93, 523	22, 066	87, 832	16, 028
British Honduras	32, 021	3, 228	30, 057	3, 072	25, 178	3, 410
Canada	7, 994, 185	677, 655	9, 158, 079	838, 734	12, 184, 077	1, 755, 690
Central American States:						
Costa Rica	118, 002	8, 878	95, 435	8, 065	10, 750	1, 643
Guatemala	58, 528	4, 084	45, 484	4, 708	19, 026	2, 584
Honduras	37, 695	3, 651	26, 168	3, 080	10, 536	1, 612
Nicaragua	36, 644	3, 064	50, 719	6, 029	33, 421	5, 115
Panama	633, 645	57, 042	454, 064	50, 793	306, 765	49, 031
Salvador	21, 404	1, 826	18, 368	2, 134	6, 691	1, 144
Mexico	1, 611, 929	132, 406	3, 707, 225	342, 564	1, 800, 185	246, 830
Miquelon, Langley, etc	957	100	3, 026	377	60	8
Newfoundland and Labrador	700	37	2, 640	286		
West Indies:						
British—						
Barbados	60, 361	5, 767	73, 610	8, 643	97, 722	18, 121
Jamaica	228, 973	19, 017	180, 965	18, 347	86, 503	14, 170
Trinidad and Tobago	267, 548	26, 060	134, 832	18, 230	372, 420	61, 443
Other British	75, 578	7, 097	103, 004	12, 001	32, 116	5, 760

[2] From Pacific Fisherman Yearbook for 1919, p. 93. Customs returns are for the fiscal year ending June 30 of the year noted.

Exports, by countries receiving, of domestic canned salmon—Continued

DETAILS, 1916 TO 1918—Continued

Country receiving	1916		1917		1918	
	Pounds	Value	Pounds	Value	Pounds	Value
NORTH AMERICA—continued						
West Indies—Continued.						
Cuba	927,129	$87,479	1,619,236	$149,492	1,632,073	$210,167
Danish	11,582	1,063	34,598	4,100	23,629	4,633
Dutch	21,599	2,122	24,673	2,782	8,370	1,683
French	4,772	477	4,770	543	548	80
Haiti	3,586	361	4,297	486	1,793	349
Santo Domingo	85,722	7,048	231,413	22,859	100,417	14,148
SOUTH AMERICA						
Argentina	273,900	23,429	191,618	19,043	353,103	61,428
Bolivia	14,579	1,466	122,092	11,724	211,978	24,478
Brazil	40,732	3,921	64,657	7,599	187,615	26,245
Chile	2,812,537	192,581	1,452,155	121,019	2,304,499	330,244
Colombia	136,254	11,514	126,861	22,575	75,477	11,479
Ecuador	245,149	16,009	276,654	25,302	215,456	28,360
Guiana—						
British	184,654	18,249	196,261	26,637	151,719	27,749
Dutch	87,398	8,048	39,050	3,888	35,143	5,812
French	26,128	2,371	17,909	1,910	26,560	3,825
Peru	523,580	36,361	434,329	37,447	1,150,276	158,794
Uruguay	23,464	1,841	5,258	590	6,630	1,509
Venezuela	195,618	16,234	297,125	28,158	181,236	26,834
ASIA						
Aden	27,716	2,817			2,832	472
China			42,017	5,177	68,949	13,372
China, leased territory:						
Japanese	96	16	192	32	144	30
Chosen	1,632	172	2,520	456	1,062	207
East Indies:						
British—						
British India	1,117,839	91,767	601,935	62,264	1,349,057	222,947
Straits Settlements	1,215,214	71,585	106,896	9,081	232,755	34,468
Other British	166,144	12,787	101,286	10,355	41,818	6,944
Dutch	727,006	81,121	374,832	42,693	405,326	66,240
French	4,712	615	6,816	1,340	240	69
Hong Kong	47,558	5,170	74,585	9,570	86,203	14,678
Japan	1,348	141	2,604	340	4,590	883
Persia	24,960	1,892	9,600	800		
Russia in Asia	48	4				
Siam	1,392	219	2,880	533	6,048	1,012
OCEANIA						
British:						
Australia and Tasmania	11,035,294	1,204,354	6,990,835	865,865	7,397,009	1,337,231
New Zealand	216,292	24,684	96,912	10,332	240,240	45,409
Other British	30,878	2,923	141,735	14,749	174,138	24,921
French	290,854	29,201	248,415	32,643	186,574	31,160
German	448,860	29,434	357,386	37,172	285,605	39,071
Philippine Islands	5,640,858	356,366	4,202,574	351,633	5,558,796	618,697
AFRICA						
British Africa:						
West	100,310	7,860	613,545	62,925	480,414	72,960
South	620,555	56,255	1,421,021	157,853	1,293,714	161,423
East			25,608	2,543	57,275	8,938
Belgian Congo			1,750	331	2,293	463
Canary Islands	10,480	1,071	7,200	432	836	115
Egypt	105,800	9,534			261,673	42,335
French Africa			2,250	235	20,268	4,255
Italian Africa	110	10				
Liberia	3,624	366	2,810	258	9,448	1,499
Portuguese Africa	37,508	3,231	138,580	13,291	52,298	7,207
Spanish Africa	9,700	911	138,580	13,291	8,845	1,175
Total	152,943,962	15,032,497	117,962,807	12,963,425	110,060,480	16,570,834
RECAPITULATION						
Europe	114,163,722	11,648,003	82,758,877	9,390,858	70,092,226	10,692,246
North America	12,322,259	1,056,904	16,196,177	1,565,409	16,840,112	2,413,649
South America	4,563,993	332,024	3,314,969	305,964	4,899,692	706,757
Asia	3,336,665	268,306	1,326,163	142,641	2,199,024	361,322
Oceania	17,659,036	1,646,962	12,037,857	1,312,394	13,842,362	2,096,439
Africa	898,298	80,298	2,328,764	246,159	2,187,064	300,371

In 1918 the practice of publishing customs figures for the calendar year instead of the fiscal year, as had prevailed previously, was inaugurated. The following tables show the exports of canned salmon, by countries, for the calendar years 1918 to 1927, inclusive:

Exports, by countries receiving, of canned salmon, calendar years 1918 and 1919

Country receiving	1918		1919	
	Pounds	Value	Pounds	Value
EUROPE				
Austria-Hungary			157,396	$33,394
Azores and Madeira Islands			432	71
Belgium	18,072	$2,539	5,179,022	970,696
Denmark			1,082,434	181,178
Finland			68,000	13,010
France	11,458,346	1,270,675	15,947,105	2,525,449
Germany			833,793	147,783
Gibraltar	273,540	44,593	370,890	85,860
Greece			2,722,686	471,555
Iceland and Faroe Islands			12,025	2,557
Italy	19,654,988	2,785,844	36,925,190	4,801,911
Malta, Gozo, etc			1,892	262
Netherlands			231,710	46,356
Norway			441,776	87,668
Portugal	662	193	200	38
Rumania			9,720	1,538
Russia in Europe			19,500	2,795
Serbia, Montenegro, and Albania			480	96
Spain			79,457	16,253
Sweden	164	40	88,012	17,158
Switzerland			12,184	2,414
Turkey in Europe			100,040	17,072
United Kingdom:				
England	43,515,880	6,742,494	66,524,438	12,788,932
Scotland	154,495	22,672	1,460,082	219,951
Ireland	1,320	286	1,459,360	197,677
NORTH AMERICA				
Bermuda	35,144	6,288	53,429	6,940
British Honduras	8,560	1,181	58,194	9,409
Canada	4,077,166	620,195	9,587,861	1,467,611
Central American States:				
Costa Rica	5,310	818	98,155	16,049
Guatemala	10,492	1,374	74,407	12,599
Honduras	3,459	488	50,936	8,693
Nicaragua	11,586	1,866	125,179	21,095
Panama	172,206	30,485	141,733	25,441
Salvador	4,290	741	29,783	5,173
Mexico	347,384	54,709	4,917,900	703,262
Miquelon, Langley, etc			3,090	751
Newfoundland and Labrador			108	21
West Indies:				
British—				
Barbados	33,074	6,305	65,114	12,947
Jamaica	77,002	12,225	367,119	51,537
Trinidad and Tobago	153,207	24,923	143,694	27,023
Other British	10,148	1,983	37,935	7,717
Cuba	428,208	60,432	1,646,913	238,858
Dominican Republic	50,887	7,973	238,502	36,503
Dutch	3,206	701	17,678	4,603
French	184	24	10,456	2,422
Haiti	1,036	190	6,199	1,393
Virgin Islands of United States	20,059	4,221	22,498	4,447
SOUTH AMERICA				
Argentina	255,950	51,437	403,019	76,052
Bolivia	94,076	8,765	84,559	13,087
Brazil	161,529	21,625	31,113	7,273
Chile	1,316,148	195,478	1,331,484	214,284
Colombia	31,816	5,493	275,050	47,078
Ecuador	40,358	5,895	368,939	55,947
Guiana:				
British	38,595	7,765	122,715	25,974
Dutch	13,769	2,380	68,581	14,336
French	5,456	778	36,562	7,007
Paraguay			240	55
Peru	290,337	41,262	1,180,989	185,839
Uruguay	6,240	1,441	47,412	9,932
Venezuela	129,457	19,907	383,120	63,321

Exports, by countries receiving, of canned salmon, calendar years 1918 and 1919—Continued

Country receiving	1918		1919	
	Pounds	Value	Pounds	Value
ASIA				
Aden	2, 400	$394	2, 880	$480
China	41, 980	8, 579	90, 232	19, 088
China, leased territory: Japanese	48	10	168	43
Chosen	42	8	5, 274	1, 246
East Indies:				
British—				
British India	367, 273	67, 256	984, 672	193, 089
Straits Settlements	111, 440	16, 021	223, 168	42, 403
Other British	26, 890	4, 495	61, 814	13, 402
Dutch	124, 502	17, 692	427, 298	71, 132
French	240	69	2, 412	692
Hong Kong	41, 424	7, 839	116, 912	22, 628
Japan	25, 968	3, 259	12, 038	1, 940
Russia in Asia			192	52
Siam	4, 800	760	2, 122	558
Turkey in Asia			20, 504	3, 646
OCEANIA				
British:				
Australia	1, 149, 888	215, 715	5, 777, 713	1, 293, 194
New Zealand	26, 592	4, 835	61, 533	13, 919
Other British	67, 674	9, 872	93, 423	16, 115
French	116, 535	19, 203	225, 429	42, 303
German	153, 840	20, 394	80, 577	12, 966
Philippine Islands	5, 291, 182	579, 410	2, 371, 736	279, 408
AFRICA				
Abyssinia			92	18
Belgian Congo	2, 354	477	14, 990	3, 251
British Africa:				
West	192, 376	33, 051	976, 463	172, 258
South	121, 990	18, 255	1, 269, 317	284, 633
East	34, 260	6, 098	5, 996	1, 417
Canary Islands			59, 790	8, 025
Egypt	261, 673	42, 335	939, 895	133, 358
French Africa	17, 136	3, 572	32, 989	7, 208
German Africa			50, 465	9, 332
Liberia	2, 633	539	8, 218	1, 761
Madagascar			48	8
Morocco			5, 688	932
Portuguese Africa	2, 788	485	31, 868	6, 839
Spanish Africa			36, 266	7, 009
Total	91, 101, 734	13, 149, 307	169, 750, 672	28, 680, 706
RECAPITULATION				
Europe	75, 077, 467	10, 869, 336	133, 727, 824	22, 631, 674
North America	5, 452, 608	837, 122	17, 696, 883	2, 664, 494
South America	2, 383, 731	362, 226	4, 333, 783	720, 185
Asia	747, 007	126, 382	1, 949, 686	370, 399
Oceania	6, 805, 711	849, 429	8, 610, 411	1, 657, 905
Africa	635, 210	104, 812	3, 432, 085	636, 049

Exports, by countries receiving, of canned salmon, calendar years 1920 and 1921

Country receiving	1920		1921	
	Pounds	Value	Pounds	Value
EUROPE				
Austria	138,476	$19,652	9,612	$2,044
Azores and Madeira Islands			1,380	264
Belgium	132,419	22,116	1,517,408	161,970
Czechoslovakia	600	220	126	14
Denmark	135,409	28,394	162,130	29,306
Estonia			[1] 96,000	[1] 20,000
France	702,913	116,856	114,576	9,811
Germany	136,149	24,135	2,122,354	103,921
Gibraltar	15,364	3,652		
Greece	301,609	50,063	509,454	44,236
Iceland and Faroe Islands	144	30	480	152
Italy	164,956	31,107	24,275	2,467
Malta, Gozo, and Cyprus Islands	42,640	7,923	24,000	1,800
Netherlands	237,966	53,418	646,567	90,457
Norway	16,977	4,268	78,835	14,694
Poland and Danzig	443	53	1,350	135
Rumania	57	19		
Russia in Europe	4,872	1,245		
Spain	216,719	35,048	489	83
Sweden	27,742	4,632	3,250	446
Turkey in Europe	118,348	21,919	40,948	3,514
United Kingdom—				
England	27,562,725	6,501,431	23,675,477	4,457,818
Scotland	815,664	256,619	615,993	127,872
Ireland	96	20		
Total	30,772,288	7,182,820	29,644,704	5,071,004
NORTH AMERICA				
Bermuda	58,261	11,715	98,562	16,309
British Honduras	43,150	6,334	23,681	2,860
Canada	1,566,129	281,368	2,779,728	416,493
Costa Rica	192,838	31,090	95,759	9,751
Guatemala	48,112	7,664	29,039	3,260
Honduras	57,859	10,013	58,180	7,393
Nicaragua	67,863	12,661	26,081	2,727
Panama	300,712	59,430	186,085	24,870
Salvador	23,982	4,539	3,459	402
Mexico	4,950,099	572,779	2,286,759	209,306
Barbados	111,925	24,346	18,962	3,702
Jamacia	401,272	61,373	61,154	11,015
Trinidad and Tobago	188,079	42,564	130,873	27,475
Other British West Indies	58,000	11,507	25,971	5,065
Cuba	1,220,910	158,125	190,416	21,008
Dominican Republic	515,114	77,852	289,016	31,224
Dutch West Indies	39,107	9,428	27,920	5,743
French West Indies	1,988	325	75	6
Haiti	12,041	2,317	4,771	680
Virgin Islands of United States	56,124	10,441	57,316	7,637
Total	9,913,565	1,395,871	6,393,807	806,926
SOUTH AMERICA				
Argentina	1,265,555	213,516	99,844	11,303
Bolivia	110,366	15,936		
Brazil	54,660	15,192	5,486	1,674
Chile	1,248,171	149,665	8,676	1,509
Colombia	740,470	135,441	80,639	12,001
Ecuador	416,076	47,943	5,136	368
British Guiana	153,891	39,421	89,262	14,772
Dutch Guiana	52,187	9,609	33,716	4,528
French Guiana	26,053	4,433	26,925	3,514
Paraguay	1,025	268	48	11
Peru	1,203,984	181,927	5,773	637
Uruguay	24,024	4,848		
Venezuela	514,108	85,342	205,189	20,503
Total	5,810,870	903,541	560,694	70,820

[1] July 1 to Dec. 31.

Exports, by countries receiving, of canned salmon, calendar years 1920 and 1921—Continued

Country receiving	1920		1921	
	Pounds	Value	Pounds	Value
ASIA				
Aden	13, 384	$2, 878	3, 000	$500
China	109, 037	27, 332	80, 377	9, 948
Kwantung, leased territory	2, 160	661	384	87
Chosen	816	239	576	122
British India	1, 347, 018	271, 892	248, 724	36, 371
British Straits Settlements	568, 470	85, 660	809, 423	54, 095
Other British East Indies	114, 779	24, 144	75, 073	11, 617
Dutch East Indies	1, 255, 519	204, 914	1, 802, 837	135, 815
French Indo-China	2, 009	679	360	98
Hong Kong	28, 404	6, 360	37, 116	6, 561
Japan	4, 176	1, 068	184, 573	10, 819
Palestine and Syria			[2] 14, 058	[2] 1, 619
Russia in Asia			65, 096	5, 518
Siam	15, 758	2, 904	1, 916	436
Turkey in Asia	244, 072	32, 157	12, 058	1, 745
Total	3, 705, 602	660, 888	3, 335, 571	275, 351
OCEANIA				
Australia	2, 879, 583	543, 185	5, 158, 273	822, 373
New Zealand	98, 916	25, 844	139, 336	25, 093
Other British Oceania	40, 164	7, 052	35, 327	3, 248
French Oceania	184, 686	34, 712	99, 234	11, 905
Philippine Islands	8, 616, 832	902, 202	4, 271, 892	313, 280
Other Oceania	220, 240	35, 581	21, 084	1, 792
Total	12, 040, 421	1, 548, 576	9, 725, 146	1, 177, 691
AFRICA				
Belgian Congo	1, 440	265	935	167
British West Africa	716, 907	129, 326	152, 225	12, 250
British South Africa	1, 425, 585	287, 183	422, 033	62, 543
British East Africa	37, 720	7, 489	683	138
Canary Islands	29, 716	5, 501	21, 419	2, 205
Egypt	173, 455	28, 419	220, 419	26, 159
French Africa	24, 006	4, 008	3, 721	577
German Africa (Kamerun, etc.)	24, 654	4, 895	348	92
Liberia	12, 425	2, 440	1, 721	218
Madagascar	31, 069	4, 550		
Morocco	4, 800	725	520	57
Portuguese Africa	91, 150	17, 002	11, 465	1, 815
Spanish Africa	16, 990	3, 234	3, 000	240
Total	2, 589, 917	495, 037	838, 489	106, 461
RECAPITULATION				
Europe	30, 772, 288	7, 182, 820	29, 644, 704	5, 071, 004
North America	9, 913, 565	1, 395, 871	6, 393, 807	806, 926
South America	5, 810, 570	903, 541	560, 694	70, 820
Asia	3, 705, 602	660, 888	3, 335, 571	275, 351
Oceania	12, 040, 421	1, 548, 576	9, 725, 146	1, 177, 691
Africa	2, 589, 917	495, 037	838, 489	106, 461
Total	64, 832, 363	12, 186, 733	50, 498, 411	7, 508, 253

[2] July 1, to Dec. 31.

Exports, by countries receiving, of canned salmon, calendar years 1922 and 1923

Country receiving	1922		1923	
	Pounds	Value	Pounds	Value
EUROPE				
Azores and Madeira Islands	360	$31		
Belgium	2, 608, 391	250, 333	814, 367	$91, 817
Denmark	102, 144	10, 301	6, 000	635
France	32, 540	2, 743	57, 700	6, 049
Germany	93, 431	11, 768	82, 918	11, 478
Greece	11, 350	1, 200	120, 041	14, 534
Hungary	48	6		
Iceland and Faroe Islands	150	8		
Italy	1, 212, 351	108, 904	194, 800	19, 210
Malta, Gozo, etc	14, 400	1, 400		
Netherlands	618, 028	77, 002	479, 836	76, 799
Norway	36, 590	3, 909	45, 192	10, 855
Poland and Danzig	107	22		
Russia in Europe	33, 000	4, 329	45, 000	3, 675
Spain	214	20	1, 008	119
Sweden	69, 506	13, 912	20, 041	3, 739
Switzerland	75, 998	10, 127		
Turkey in Europe	48, 760	4, 640	12, 560	1, 581
Ukraine	329, 840	28, 134	572	157
England	23, 937, 667	3, 732, 859	31, 090, 188	5, 685, 074
Scotland	346, 200	67, 407	637, 768	125, 416
Ireland			40, 800	7, 700
Total	29, 571, 075	4, 329, 055	33, 648, 791	6, 058, 838
NORTH AMERICA				
Canada, Maritime Provinces	25, 438	3, 537	13, 742	1, 667
Quebec and Ontario	599, 834	67, 487	245, 809	29, 848
Canada, Prairie Provinces	79, 840	14, 241	23, 560	3, 665
British Columbia and Yukon	3, 175, 943	321, 872	1, 073, 172	137, 562
British Honduras	27, 234	3, 193	36, 375	3, 926
Costa Rica	187, 848	17, 193	87, 393	9, 353
Guatemala	50, 271	5, 168	51, 066	5, 605
Honduras	66, 924	9, 021	69, 266	8, 753
Nicaragua	42, 003	4, 309	89, 027	9, 553
Panama	283, 390	35, 599	220, 927	29, 459
Salvador	8, 564	994	16, 800	1, 807
Mexico	2, 819, 248	227, 649	1, 654, 380	143, 263
Miquelon and St. Pierre Islands	2, 400	200		
Bermuda	41, 302	6, 440	41, 326	8, 134
Barbados	22, 262	3, 450	118, 346	16, 008
Jamaica	85, 548	10, 038	86, 171	15, 592
Trinidad and Tobago	117, 381	18, 670	139, 119	22, 499
Other British West Indies	48, 284	8, 048	67, 570	12, 107
Cuba	434, 803	38, 397	844, 877	82, 169
Dominican Republic	167, 784	15, 417	190, 885	20, 271
Dutch West Indies	32, 418	5, 553	39, 942	6, 902
French West Indies	912	73	700	82
Haiti	2, 356	398	4, 084	575
Virgin Islands of United States	42, 014	5, 178	30, 454	3, 829
Total	8, 364, 001	822, 125	5, 144, 991	572, 629
SOUTH AMERICA				
Argentina	477, 872	48, 188	1, 021, 474	116, 777
Bolivia	125, 560	10, 483	65, 676	6, 154
Brazil	14, 400	3, 075	3, 491	741
Chile	1, 893, 557	181, 242	216, 696	23. 299
Colombia	290, 178	31, 592	414, 017	47, 561
Ecuador	237, 196	23, 317	117, 542	10, 832
British Guiana	99, 632	17, 144	212, 694	37, 525
Dutch Guiana	76, 928	9, 517	32, 497	3, 594
French Guiana	2, 783	400	9, 948	1, 164
Paraguay			840	105
Peru	42, 353	4, 342	426, 163	45, 684
Uruguay	3, 120	556	8, 096	1, 404
Venezuela	555, 873	56, 473	577, 041	58, 614
Total	3, 819, 452	386, 329	3, 106, 175	553, 454

Exports, by countries receiving, of canned salmon, calendar years 1922 and 1923—Continued

Country receiving	1922		1923	
	Pounds	Value	Pounds	Value
ASIA				
Aden	24,000	$1,900	480	$60
Armenia and Kurdistan	350	36		
British India	769,867	95,127	205,472	30,766
Ceylon	88,276	10,282	54,931	8,607
Straits Settlements	1,893,804	160,220	115,750	19,431
Other British East Indies	1,516	88	2,736	350
China	83,459	13,321	51,357	8,295
Chosen	1,692	343	5,610	635
Java and Madura	1,687,365	149,187	249,343	27,207
Other Dutch East Indies	249,466	25,830	115,724	11,961
French Indo-China	9,168	1,187	240	51
Greece in Asia	9,600	940		
Hong Kong	86,364	13,297	24,710	4,307
Japan	5,606	714	1,577,926	150,328
Kwantung, leased territory			144	32
Palestine and Syria	54,321	5,076	31,588	3,676
Russia in Asia			1,491	159
Siam	158,538	13,775	2,916	794
Turkey in Asia	4,800	500	19,200	2,280
Other Asia			336	29
Total	5,128,192	491,823	2,459,954	268,968
OCEANIA				
Australia	6,663,952	1,045,545	6,142,166	999,702
British Oceania	88,472	8,487	27,317	3,871
French Oceania	164,122	18,547	190,548	21,263
New Zealand	149,598	26,413	153,854	28,405
Other Oceania	108,454	10,674	33,893	3,688
Philippine Islands	7,719,124	610,114	7,055,041	667,713
Total	14,893,722	1,719,780	13,602,819	1,724,642
AFRICA				
Belgian Congo	1,268	205	1,498	216
British West Africa	59,998	6,363	34,778	3,631
British South Africa	1,724,928	181,061	1,495,449	160,324
British East Africa	15,360	1,591	450	97
Canary Islands	44,792	4,586	8,202	742
Egypt	73,408	9,193	41,755	5,572
Other French Africa	732	75	384	54
Liberia	3,930	403	1,684	195
Morocco	4,925	606	1,353	186
Portuguese East Africa	88,973	8,814	46,095	5,150
Other Portuguese Africa	48	11	44	13
Spanish Africa	2,475	355		
Total	2,020,837	213,263	1,631,692	176,180
RECAPITULATION				
Europe	29,571,075	4,329,055	33,648,791	6,058,838
North America	8,364,001	822,125	5,144,991	572,629
South America	3,819,452	386,329	3,106,175	353,454
Asia	5,128,192	491,823	2,459,954	268,968
Oceania	14,893,722	1,719,780	13,602,819	1,724,642
Africa	2,020,837	213,263	1,631,692	176,180
Total	63,797,279	7,962,375	59,594,422	9,154,711

Exports, by countries receiving, of canned salmon, calendar years 1924 and 1925

Country receiving	1924		1925	
	Pounds	Value	Pounds	Value
EUROPE				
Austria			3,720	$624
Azores, and Madeira Islands	332	$55	600	113
Belgium	1,337,489	138,779	803,068	110,340
Czechoslovakia			1,200	178
Denmark	9,600	1,488	27,863	3,422
Finland			5,040	593
France	42,659	7,855	16,844	1,992
Germany	150,167	20,820	31,988	5,129
Gibraltar	1,536	227		
Greece	494,062	57,988	674,003	78,126
Irish Free State			37,400	4,640
Italy	107,880	10,594	49,632	4,447
Malta, Gozo, and Cyprus Islands	1,528	253		
Netherlands	622,228	89,085	521,259	93,282
Norway	21,120	2,628	19,600	1,975
Poland and Danzig			96	25
Rumania	3,720	639		
Russia in Europe			5,294	770
Spain			2,400	520
Sweden	14,160	2,223	23,304	3,059
Switzerland	4,800	520	24,000	2,700
Turkey in Europe	38,400	1,280	9,600	892
United Kingdom			24,978,401	5,145,443
England	36,485,985	5,865,023		
Scotland	391,100	60,689		
Ireland	308,120	36,621		
Total	40,034,886	6,296,767	27,235,312	5,458,270
NORTH AMERICA				
Canada	2,051,011	264,052	2,581,457	327,003
British Honduras	24,910	2,763	47,895	4,786
Costa Rica	139,776	13,793	88,319	10,967
Guatemala	71,388	8,043	32,467	3,575
Honduras	52,478	6,715	56,979	7,487
Nicaragua	109,730	13,208	115,476	13,323
Panama	277,357	36,579	321,743	44,946
Salvador	5,814	729	9,360	1,196
Mexico	2,482,065	227,473	2,013,017	172,483
Miquelon and St. Pierre Islands			5,660	435
Newfoundland and Labrador	96	18	610	64
Bermuda	46,485	8,943	19,640	4,956
Barbados	43,024	7,222	7,857	1,342
Jamaica	52,956	10,951	45,311	10,360
Trinidad and Tobago	37,910	7,082	19,760	4,897
Other British West Indies	45,744	7,771	42,546	7,248
Cuba	647,574	66,161	404,760	41,033
Dominican Republic	230,416	23,643	286,842	30,928
Dutch West Indies	37,026	6,901	34,602	7,668
French West Indies	2,068	181	240	29
Haiti	5,365	897	6,502	1,076
Virgin Islands of United States	37,989	4,496	48,475	5,883
Total	6,401,182	717,621	6,189,518	701,685
SOUTH AMERICA				
Argentina	218,068	24,048	155,276	16,181
Bolivia	25,918	2,896	41,812	4,052
Brazil	13,033	2,442	28,347	4,637
Chile	154,006	23,192	297,873	47,583
Colombia	558,147	64,456	567,260	64,580
Ecuador	112,538	12,611	215,669	21,555
Falkland Islands	48	11		
British Guiana	58,742	11,819	107,966	25,852
Dutch Guiana	42,346	4,957	18,913	2,739
French Guiana	12,586	1,470	20,040	2,381
Paraguay	720	109	960	160
Peru	226,972	23,285	319,252	34,764
Uruguay	18,130	2,424	10,664	1,888
Venezuela	957,426	103,093	582,055	63,996
Total	2,398,680	276,813	2,366,087	290,368

Exports, by countries receiving, of canned salmon, calendar years 1924 and 1925—Continued

Country receiving	1924		1925	
	Pounds	Value	Pounds	Value
ASIA				
Aden	1, 340	$188	960	$151
British India	439, 559	74, 608	357, 201	69, 327
Ceylon	134, 750	19, 412	261, 192	42, 499
Straits Settlements	175, 130	18, 210	129, 559	19, 371
Other British East Indies			7, 536	973
China	100, 425	17, 828	286, 311	36, 226
Chosen	768	112	344	41
Java and Madura	260, 822	32, 483	162, 723	23, 313
Other Dutch East Indies	79, 128	10, 400	106, 035	12, 488
French Indo-China			96	14
Hejaz, Arabia, etc	1, 680	144	3, 826	415
Hong Kong	59, 852	9, 327	88, 358	12, 654
Japan	249, 350	27, 847	102, 106	15, 306
Kwantung, leased territory	144	38	96	13
Palestine and Syria	14, 269	1, 601	6, 936	927
Persia			1, 200	175
Siam	3, 469	1, 386	5, 384	1, 175
Turkey in Asia	9, 600	1, 280	9, 100	910
Other Asia			4, 529	717
Total	1, 530, 286	214, 864	1, 533, 492	236, 695
OCEANIA				
Australia	7, 167, 084	1, 186, 765	6, 966, 059	1, 491, 392
British Oceania	23, 464	3, 016	37, 121	5, 294
French Oceania	246, 556	27, 170	235, 122	25, 966
New Zealand	102, 078	17, 289	159, 624	35, 617
Other Oceania	59, 381	7, 218	34, 700	4, 409
Philippine Islands	7, 884, 986	793, 939	7, 533, 837	709, 599
Total	15, 483, 549	2, 035, 397	14, 966, 463	2, 272, 277
AFRICA				
Belgian Congo	1, 587	338	5, 275	918
British West Africa	75, 162	6, 820	164, 621	14, 273
British South Africa	980, 445	105, 558	617, 387	72, 348
British East Africa	15, 816	2, 120	8, 276	1, 149
Canary Islands	8, 388	695	7, 968	1, 781
Egypt	27, 376	4, 499	21, 534	4, 520
Other French Africa	636	92	332	65
Liberia	3, 164	323	5, 644	925
Portuguese East Africa	45, 648	4, 505	29, 414	3, 235
Other Portuguese Africa	444	75	793	244
Spanish Africa	6, 120	639	19, 500	1, 950
Total	1, 116, 786	125, 664	880, 744	101, 408
RECAPITULATION				
Europe	40, 034, 886	6, 296, 767	27, 235, 312	5, 458, 270
North America	6, 401, 182	717, 621	6, 189, 518	701, 685
South America	2, 398, 680	276, 813	2, 366, 087	290, 368
Asia	1, 530, 286	214, 864	1, 533, 492	236, 695
Oceania	15, 483, 549	2, 035, 397	14, 966, 463	2, 272, 277
Africa	1, 164, 786	125, 664	880, 744	101, 408
Total	67, 013, 369	9, 667, 126	53, 171, 616	9, 060, 703

Exports, by countries receiving, of canned salmon, calendar years 1926 and 1927

Country receiving	1926		1927	
	Pounds	Value	Pounds	Value
EUROPE				
Austria	2,020	$263	1,400	$180
Azores and Madeira Islands	773	139	12,002	1,261
Belgium	732,117	100,312	398,945	51,900
Czechoslovakia	2,500	300	2,400	325
Denmark	48,772	6,835	11,328	1,266
Finland	620	132	1,200	175
France	329	102	29,212	4,445
Germany	181,461	24,440	76,358	12,164
Gibraltar	1,200	135	1,200	160
Greece	584,456	65,382	495,122	54,593
Irish Free State	60,000	12,550	31,900	3,535
Italy	80,400	9,445	293,078	34,404
Malta, Gozo, and Cyprus Islands	5,664	1,144	4,390	758
Netherlands	653,940	102,666	367,868	69,011
Norway	31,255	8,139	20,230	2,829
Portugal	1,444	235	1,572	239
Rumania	48	11	1,392	301
Soviet Russia in Europe	740	179		
Spain	25,420	4,245	18,240	3,099
Sweden	29,576	6,165	19,521	3,970
Switzerland	47,520	5,454	14,400	1,707
Turkey in Europe	1,615	278	25,872	2,743
United Kingdom	25,357,747	4,596,052	20,736,856	3,529,255
Total	27,849,617	4,944,603	22,564,486	3,778,320
NORTH AMERICA				
Canada	1,681,771	287,976	1,692,648	269,600
British Honduras	32,360	3,744	21,129	2,653
Costa Rica	109,451	15,261	119,767	16,059
Guatemala	50,565	7,168	44,354	5,824
Honduras	44,954	5,706	43,403	5,970
Nicaragua	91,070	10,898	84,523	9,519
Panama	266,432	43,109	242,859	40,465
Salvador	12,170	1,533	6,029	781
Mexico	2,084,845	191,699	803,559	73,614
Miquelon and St. Pierre Islands	1,020	140	490	55
Bermuda	21,268	5,274	24,543	6,211
Barbados	30,248	6,029	8,576	1,821
Jamaica	32,998	9,586	70,661	15,900
Trinidad and Tobago	60,853	13,111	30,145	7,091
Other British West Indies	53,785	9,355	36,602	6,864
Cuba	639,796	66,994	312,383	36,521
Dominican Republic	270,073	31,914	209,166	22,566
Dutch West Indies	46,350	10,301	46,938	11,624
French West Indies	96	13	1,156	152
Haiti, Republic of	11,404	1,731	9,262	1,489
Virgin Islands of United States	42,777	5,201	42,754	5,313
Total	5,584,286	726,743	3,850,947	540,092
SOUTH AMERICA				
Argentina	275,488	35,323	18,472	4,117
Bolivia	18,989	2,872	21,921	2,716
Brazil	18,193	4,643	9,871	2,278
Chile	875,131	126,062	101,872	15,973
Colombia	628,132	81,120	716,104	89,855
Ecuador	46,236	5,036	25,870	3,437
Falkland Islands	192	43	568	87
British Guiana	95,254	21,260	45,596	10,028
Dutch Guiana	21,138	3,508	12,109	1,980
French Guiana	3,840	522	15,308	2,036
Paraguay	1,015	214	1,905	304
Peru	199,563	24,531	77,215	9,950
Uruguay	14,956	2,411	13,119	2,135
Venezuela	481,831	59,762	311,729	41,963
Total	2,679,958	367,307	1,371,659	186,859

Exports, by countries receiving, of canned salmon, calendar years 1926 and 1927—Continued

Country receiving	1926		1927	
	Pounds	Value	Pounds	Value
ASIA				
Aden	5,717	$778	4,630	$503
Arabia and Hejaz	1,900	210	2,992	291
British India	526,487	82,878	416,160	61,965
British Malaya	236,438	38,156	181,235	28,671
Ceylon	333,669	44,331	209,511	28,720
China	245,509	31,676	63,160	9,175
Java and Madura	191,276	28,449	241,642	25,510
Other Dutch East Indies	129,730	16,527	83,705	13,080
French Indo-China	576	90	624	70
Hong Kong	28,100	6,292	38,432	8,378
Iraq	7,200	915	2,784	329
Japan	122,424	12,018	1,448	240
Kwantung Leased Territory	480	105	48	24
Palestine	7,880	966	7,152	1,139
Persia			279	88
Siam	4,294	1,025	2,012	599
Syria			342	101
Turkey in Asia	384	82	1,200	250
Other Asia	144	21	1,200	150
Total	1,842,298	264,519	1,258,556	179,283
OCEANIA				
Australia	6,370,522	1,299,712	3,561,061	709,782
British Oceania	75,914	9,793	100,382	18,662
French Oceania	218,266	24,175	147,413	17,178
New Zealand	228,784	44,979	60,080	12,578
Philippine Islands	8,140,977	824,512	4,742,208	499,526
Total	15,034,463	2,203,171	8,611,144	1,257,726
AFRICA				
Belgian Congo	3,489	400	3,012	417
British East Africa	25,536	3,697	21,360	3,724
British South Africa	318,165	45,392	385,075	60,937
British West Africa	51,120	5,359	84,624	8,189
Egypt	82,064	11,596	54,237	8,110
Other French Africa	720	95		
Liberia	365	115	1,901	304
Morocco	1,200	135	1,440	156
Mozambique	19,293	3,012	25,064	2,880
Other Portuguese Africa	812	223	1,231	431
Canary Islands	17,712	1,854	13,196	1,532
Total	520,476	71,878	591,040	86,680
RECAPITULATION				
Europe	27,849,617	4,944,603	22,564,486	3,778,320
North America	5,584,286	726,743	3,850,947	540,092
South America	2,679,958	367,307	1,371,659	186,859
Asia	1,842,298	264,519	1,258,556	179,283
Oceania	15,034,463	2,203,171	8,611,144	1,257,726
Africa	520,476	71,878	591,040	86,680
Total	53,511,098	8,578,221	38,247,832	6,028,960

The following tables show in summarized form the customs districts from which canned salmon was exported for the years 1900 to 1915, inclusive, and in detailed form for the years 1916 to 1927, inclusive. Up to 1910 about two-thirds of the total exports have gone from the port of San Francisco, while about one-fifth of the total passed through the port of Puget Sound, Wash. In 1910 the exports from Puget Sound exceeded those from San Francisco and, although San Francisco regained the lead for a few years, Puget Sound has maintained first place since 1918. The only other port through which any considerable quantity is shipped is New York City. It is usual now to load the salmon on steamers and sailing vessels at San Francisco and the Puget Sound cities to go direct to Europe.

Exports, by customs districts, of canned salmon

SUMMARY, 1900 TO 1915 [1]

Customs district from which exported	1900		1901		1902		1903	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Atlantic ports	3, 820, 656	$370, 302	8, 834, 322	$947, 729	4, 538, 073	$427, 335	5, 734, 469	$611, 868
Gulf ports	38, 868	3, 430	55, 425	5, 426	50, 116	4, 965	54, 016	5, 085
Mexican border ports	30, 264	2, 861	20, 140	2, 082	188, 346	15, 498	130, 363	11, 741
Pacific ports	23, 168, 445	2, 314, 541	32, 337, 112	3, 270, 524	42, 357, 217	3, 539, 231	44, 391, 379	3, 716, 926
Northern border and Lake ports	24, 137	2, 514	42, 501	4, 510	39, 362	4, 373	43, 107	5, 171

Customs district from which exported	1904		1905		1906	
	Pounds	Value	Pounds	Value	Pounds	Value
Atlantic ports	2, 133, 121	$214, 332	2, 693, 503	$267, 263	3, 277, 571	$318, 321
Gulf ports	72, 792	6, 455	97, 561	8, 425	127, 255	10, 910
Mexican border ports	355, 248	24, 183	289, 439	23, 148	455, 413	36, 130
Pacific ports	53, 362, 492	4, 979, 565	31, 957, 252	2, 734, 269	41, 906, 406	3, 469, 472
Northern border and Lake ports	625	63	28, 800	2, 364	177, 769	13, 110

Customs district from which exported	1907		1908		1909	
	Pounds	Value	Pounds	Value	Pounds	Value
Atlantic ports	2, 314, 535	$227, 779	2, 334, 663	$227, 113	4, 043, 807	$409, 933
Gulf ports	165, 050	14, 450	206, 120	19, 245	107, 018	8, 954
Mexican border ports	570, 343	47, 776	723, 689	65, 119	219, 128	21, 574
Pacific ports	22, 160, 349	1, 892, 398	24, 961, 173	2, 126, 995	31, 705, 144	2, 971, 984
Northern border and Lake ports	7, 828	646	400	46	42, 012	3, 991

Customs district from which exported	1910		1911		1912	
	Pounds	Value	Pounds	Value	Pounds	Value
Atlantic ports	3, 003, 430	$306, 122	1, 564, 485	$166, 971	2, 506, 989	$257, 792
Gulf ports	118, 559	9, 554	159, 359	15, 194	109, 045	12, 029
Mexican border ports	254, 717	21, 503	213, 226	20, 393	415, 259	38, 455
Pacific ports	60, 450, 190	5, 974, 196	36, 663, 729	3, 834, 584	40, 391, 058	4, 312, 116
Northern border and Lake ports	33, 800	2, 883	----------	----------	1, 405	171

Customs district from which exported	1913		1914		1915	
	Pounds	Value	Pounds	Value	Pounds	Value
New York	1, 935, 881	$189, 959	2, 404, 220	$207, 924	5, 316, 456	$512, 549
New Orleans	----------	----------	182, 717	19, 787	261, 709	28, 682
El Paso	----------	----------	120, 140	9, 045	176, 390	12, 348
San Francisco	31, 687, 774	3, 277, 841	38, 844, 912	3, 600, 636	35, 321, 058	4, 209, 914
Oregon	624, 000	83, 000	124, 512	9, 391	671, 452	64, 517
Washington	19, 827, 745	1, 434, 451	45, 876, 703	4, 038, 449	41, 064, 868	4, 183, 410
All other districts	1, 215, 566	118, 089	197, 716	14, 061	634, 183	60, 663

[1] Detailed statistics for 1900 to 1915, inclusive, may be found in Pacific Salmon Fisheries, by John N. Cobb, Appendix III, Report U. S. Commissioner of Fisheries, 1916, pp. 194–198. Washington, 1917.

Exports, by customs districts, of canned salmon—Continued

DETAILS, 1916 TO 1918

Customs district from which exported	1916		1917		1918	
	Pounds	Value	Pounds	Value	Pounds	Value
Georgia	--------	--------	156,000	$37,052	96	$24
Maine and New Hampshire	2,583,306	$274,432	1,186,871	160,399	3,336	621
Maryland	517,800	47,603	1,884,672	168,537	1,208,142	149,080
Massachusetts	1,314,778	130,701	2,447,156	279,184	789,629	159,052
New York	24,257,388	2,339,629	23,993,032	2,607,602	49,034,077	7,690,025
Philadelphia	111,578	8,680	2,445,373	237,540	302,740	40,431
Porto Rico	9,813	578	3,060	384	6,106	839
Virginia	2,589,040	211,848	5,969,268	551,269	489,242	82,563
Florida	4,252	350	9,971	672	7,262	1,623
Galveston	3,211	159	30,096	3,467	16,457,201	2,124,530
Mobile	7,635	851	7,055	686	6,505	838
New Orleans	1,125,031	109,238	8,003,488	967,410	1,720,839	223,676
Sabine	4,867	428	8,244	1,233	5,411	1,325
Arizona	134,358	10,263	170,372	15,005	97,046	12,228
Eagle Pass	37,922	3,496	95,077	7,783	--------	--------
El Paso	117,715	8,876	196,331	15,878	105,630	12,547
San Antonio	--------	--------	--------	--------	401,640	47,445
Laredo	252,826	16,637	367,324	33,159	--------	--------
Alaska	87,371	6,319	3,094,290	267,489	5,396,783	691,897
Hawaii	78	15	137,328	13,959	56,044	8,195
Oregon	657,121	60,257	303,888	36,105	--------	--------
San Francisco	53,221,608	5,845,811	32,390,693	3,910,592	18,278,622	3,153,508
Southern California	33,455	2,463	35,133	3,758	30,009	4,327
Washington	60,520,904	5,461,097	30,549,747	3,034,487	13,783,070	1,874,726
Buffalo	850	107	5,437	722	250	25
Dakota	--------	--------	66,825	5,906	2,630	437
Duluth and Superior	--------	--------	171	39	15	1
Michigan	1,949,086	207,808	3,354,350	427,810	1,814,899	284,746
Montana and Idaho	3,389,969	283,727	987,925	166,323	1,248	222
St. Lawrence	--------	--------	100	28	61,990	5,901
Vermont	12,000	1,124	63,530	8,957	18	2
Total	152,943,962	15,032,497	117,962,807	12,963,425	110,060,480	16,570,834

In 1918 was inaugurated the practice of publishing customs figures, for calendar years instead of, as previously, for the fiscal year ending June 30. The following tables show the exports of canned salmon by customs districts for the calendar years 1918 to 1927:

Exports, by customs districts, of canned salmon, calendar years 1918 to 1927, inclusive

Customs district from which exported	1918		1919		1920	
	Pounds	Value	Pounds	Value	Pounds	Value
Georgia	99	$25	--------	--------	--------	--------
Maine and New Hampshire	96	24	130,994	$27,831	87,519	$27,223
Maryland	1,705,877	220,669	2,385,585	411,895	448,229	93,029
Massachusetts	517,456	84,118	331,296	58,267	326,609	85,724
New York	46,490,264	7,500,562	85,463,019	13,977,432	15,538,924	2,932,488
Philadelphia	305,414	42,261	2,593,197	322,858	602,458	156,533
Porto Rico	1,711	394	7,458	1,262	35,983	5,032
Virginia	303,650	44,586	1,203,496	211,701	465,425	104,940
Florida	--------	--------	171,653	20,673	9,745	1,726
Galveston	15,169,801	1,942,094	11,156,255	1,357,799	3,935	1,324
Mobile	3,567,735	482,945	1,654,115	219,879	207,480	36,165
New Orleans	542,161	80,586	10,060,979	1,613,503	2,905,887	347,346
Sabine	3,033	833	16,439	3,354	37,343	8,025
Arizona	30,063	4,319	118,946	17,726	115,728	14,763
El Paso	21,290	2,891	320,836	41,491	456,784	45,534
San Antonio	46,914	7,373	855,588	116,612	1,040,304	104,151
Alaska	72	12	1,594,476	188,038	624	95
Hawaii	48,428	7,052	49,232	7,718	11,812	2,732
Oregon	--------	--------	244,600	56,080	770,092	148,713
San Francisco	4,490,375	749,095	19,596,548	4,359,336	15,626,294	3,671,489
Southern California	34,045	5,159	125,793	21,856	--------	--------
Washington	16,422,108	1,764,105	27,911,740	4,930,335	24,818,862	4,118,562
Buffalo	501	75	863,795	140,568	1,748	375
Dakota	2,541	437	90,206	19,841	524	176
Duluth and Superior	--------	--------	13,460	2,996	--------	--------
Michigan	1,345,300	200,873	1,057,458	199,096	466,041	76,374
Montana and Idaho	--------	--------	1,527,576	281,707	753,010	184,596
St. Lawrence	52,800	8,819	163,063	26,108	696	168
Vermont	--------	--------	42,869	8,144	--------	--------
San Diego	--------	--------	--------	--------	53,108	11,417
Los Angeles	--------	--------	--------	--------	47,199	8,033
Total	91,101,734	13,149,307	169,750,672	28,644,706	64,832,363	12,186,733

Exports, by customs districts, of canned salmon, calendar years 1918 to 1927, inclusive—Continued

Customs district from which exported	1921		1922		1923	
	Pounds	Value	Pounds	Value	Pounds	Value
South Carolina	350	$35				
Virginia			38,750	$3,030		
Maine and New Hampshire	294	47	48	11	82	$7
Massachusetts	192,048	30,813	52,052	9,143	13,660	1,660
Maryland	35,069	2,510	72,600	8,810		
New York	4,032,364	561,486	6,613,597	699,810	4,271,731	505,127
Philadelphia	226,324	27,025	67,715	10,916		
Buffalo			211,544	12,541	70,636	9,107
Porto Rico	22,892	2,371	19,336	1,922	19,278	2,283
Florida	7,516	1,400	9,555	1,758	11,081	1,871
Galveston	19,375	2,819	1,016	96		
New Orleans	769,020	67,294	1,320,427	102,464	1,380,298	115,598
Mobile	5,870	518	36,627	2,809	22,380	2,518
Sabine	33,283	3,835	6,262	798	2,980	378
Arizona	35,589	3,220	28,318	2,822	48,782	4,851
El Paso	256,235	22,642	315,754	27,533	145,043	13,434
San Antonio	299,654	25,940	193,587	16,427	148,161	11,868
Alaska	1,056	263	370,048	35,674	281,014	33,294
San Francisco	14,374,795	2,639,684	10,145,853	1,619,688	16,556,708	2,834,286
San Diego	51,652	6,811	24,810	3,301		
Los Angeles	44,391	4,864	10,438	992	69,387	5,465
Hawaii	363	172	2,408	525	320	48
Washington	24,311,192	3,210,872	40,168,916	4,902,559	33,038,739	5,016,966
Oregon	4,876,417	732,026	3,779,494	453,716	3,358,262	577,181
Duluth and Superior	68	16	130	19		
Dakota	1,188	314	10,904	2,162	570	180
Michigan	892,797	159,469	229,000	33,165	764	158
Montana and Idaho	7,270	1,413	130	22	105	14
Ohio	96	12				
St. Lawrence	1,243	382	184	47	58,321	6,954
Vermont			67,776	9,615	96,120	11,463
Total	50,498,411	7,508,253	63,797,279	7,962,375	59,594,422	9,154,711

Customs district from which exported	1924		1925		1926	
	Pounds	Value	Pounds	Value	Pounds	Value
Maine and New Hampshire	63	$12	45	$7	70,000	$14,329
Massachusetts	96,064	17,448	2,449	350	52,064	10,726
Maryland	68,000	10,340				
New York	4,138,407	499,933	3,164,954	390,088	2,224,341	400,543
Philadelphia	1,820	156	2,370	240	1,050	92
Buffalo	910	219	180	55	136,479	17,234
Porto Rico	29,490	3,236	64,264	6,716	142,941	15,365
Rhode Island	480	40				
Florida	7,400	1,375	5,162	950	5,028	884
Galveston	138	18				
New Orleans	1,592,318	153,888	1,349,392	114,561	1,452,184	140,522
Mobile	3,860	327	3,040	284	4,543	566
Sabine	1,571	302	1,152	300		
Arizona	37,256	3,864	56,817	6,101	30,270	3,484
El Paso	99,068	13,085	74,256	8,254	57,175	8,975
San Antonio	828,017	62,996	87,333	8,982	755,721	64,192
Alaska	437,885	50,709	976,745	142,795	479,678	69,266
San Francisco	19,412,016	3,383,007	13,473,136	2,884,790	15,093,267	2,638,090
Georgia	70	14	240	29		
Los Angeles	122,938	8,576	15,388	1,843	48,609	4,454
Hawaii	24	10	337	58	98	29
Washington	33,424,148	4,520,928	27,475,180	4,301,397	29,947,081	4,662,609
Oregon	6,705,384	935,565	6,409,937	1,191,835	2,980,644	520,603
Dakota	103	37	7,200	501	11,880	2,500
Michigan	300	45			14,749	3,017
Montana and Idaho					10	4
St. Lawrence	5,254	963	2,039	567	786	227
Vermont	385	33			2,500	510
Total	67,013,369	9,667,126	53,171,616	9,060,703	53,511,098	8,578,221

Exports, by customs districts, of canned salmon, calendar years 1918 to 1927, inclusive—Continued

Customs district from which exported	1927		Customs district from which exported	1927	
	Pounds	Value		Pounds	Value
Maine and New Hampshire	25, 200	$5, 250	El Paso	10, 244	$1, 737
Vermont	6, 000	990	Arizona	19, 763	2, 325
Massachusetts	13, 401	2, 694	Los Angeles	45, 193	5, 784
St. Lawrence	38, 100	3, 880	San Francisco	9, 035, 513	1, 653, 460
Buffalo	32, 667	6, 863	Oregon	1, 555, 903	330, 206
New York	2, 027, 752	310, 960	Washington	24, 391, 190	3, 601, 511
Philadelphia	3, 082	281	Alaska	27, 936	4, 026
Georgia	70	23	Hawaii	175	52
Florida	5, 367	907	Dakota	2, 400	500
Mobile	5, 059	592	Michigan	8, 442	1, 808
New Orleans	552, 174	59, 670	Porto Rico	50, 846	6, 025
Galveston	355	60	Total	38, 247, 932	6, 028, 960
San Antonio	391, 100	29, 356			

EXPORTS OF DOMESTIC FRESH AND CURED SALMON

The following tables show in summarized form the value of the exports of fresh and cured salmon, by countries to which exported, for the period 1900 to 1915, inclusive, and in detailed form for the years 1916 to 1927, inclusive. As with the canned salmon, the greater part of these exports go to European countries, Germany, under ordinary conditions, taking by far the largest quantity. A small portion of this is salmon caught in Atlantic waters.

Exports, by countries receiving, of domestic fresh and cured salmon

SUMMARY, FISCAL YEARS 1900 TO 1915 [1]

Country receiving	1900	1901	1902	1903	1904	1905
Europe	$340, 643	$344, 368	$496, 637	$760, 197	$1, 094, 950	$1, 748, 039
North America	87, 964	60, 416	132, 704	67, 225	36, 408	25, 809
South America	1, 702	901	3, 063	1, 690	1, 822	3, 438
Asia	3, 324	15, 037	25, 843	5, 393	1, 382	30, 170
Oceania	101, 388	5, 982	35, 863	34, 835	28, 063	25, 085
Africa	255	24	325	12	864	114

Country receiving	1906	1907	1908	1909	1910
Europe	$1, 776, 086	$1, 794, 885	$1, 587, 535	$1, 225, 948	$1, 468, 015
North America	36, 943	23, 204	27, 263	28, 383	29, 688
South America	2, 600	2, 351	517	1, 365	5, 242
Asia	92, 861	19, 384	3, 962	3, 640	348
Oceania	18, 914	38, 721	28, 767	28, 935	28, 079
Africa	60	198		289	1, 268

Country receiving	1911	1912	1913	1914	1915
Europe	$1, 511, 184	$1, 587, 973	$2, 055, 109	$2, 074, 499	$1, 375, 123
North America	24, 880	20, 350	34, 741	86, 087	20, 336
South America	384	142	3, 409	933	618
Asia	3, 933	107	1, 398	2, 428	1, 362
Oceania	32, 334	21, 575	25, 699	31, 330	27, 420
Africa	424	4	2, 210	32	

[1] Detailed statistics for 1900 to 1915, inclusive, may be found in Pacific Salmon Fisheries, by John N. Cobb, Appendix III, Report, U. S. Commissioner of Fisheries, 1916, pp. 198–201. Washington, 1917.

Exports, by countries receiving, of domestic fresh and cured salmon—Continued

DETAILS, FISCAL YEARS 1916 TO 1918

Country receiving	1916	1917	[2] 1918
EUROPE			
Denmark	$193, 124	$33, 874	
France	2		$3, 900
Greece	2, 898	1, 844	
Iceland, and Faroe Islands	365	237	
Italy		6, 418	10
Netherlands	10, 961	4, 614	
Norway	194, 868	134, 676	
Spain	316		
Sweden	145, 613	27, 346	
United Kingdom: England	147, 955	155, 089	30, 747
NORTH AMERICA			
Bermuda	688	1, 002	600
British Honduras	115	1	5
Canada	12, 872	79, 676	55, 976
Central American States:			
Costa Rica	169	14	
Guatemala	75	61	18
Honduras	149	112	5
Nicaragua	249	97	81
Panama	6, 364	2, 973	2, 308
Salvador	117	76	3
Mexico	9, 909	3, 388	3, 186
Newfoundland and Labrador	15		
West Indies:			
British—			
Barbados	944	564	12
Jamaica	3, 689	806	122
Trinidad and Tobago	102	1, 635	
Other British	1, 352	801	26
Cuba	6, 563	2, 274	2, 578
Danish	257	902	379
Dominican Republic	967	1, 875	448
Dutch	574	382	52
French	61	65	
Haiti	525	435	290
SOUTH AMERICA			
Argentina	111	140	9
Bolivia	87	129	35
Brazil	424	537	112
Chile	735	39	243
Colombia	1, 164	435	869
Ecuador	263	45	31
Guiana:			
British	940	158	
Dutch	380	817	6
French	407	230	25
SOUTH AMERICA—con.			
Peru	$929	$742	
Uruguay	95		
Venezuela	2, 998	779	362
ASIA			
China	23	111	95
China, leased territory—Japanese		100	
Chosen	7		4
East Indies:			
British—			
British India	102	22	22
Straits Settlements			50
Other British	9		
Dutch	1, 735		438
French		35	
Hong Kong	43	9	
Japan	22	56	286
Russia in Asia	243		
OCEANIA			
British:			
Australia	31, 815	21, 058	155
New Zealand	81	23	
Other British	61	86	73
French	1, 285	1, 039	235
German	442	1, 062	1, 363
Philippine Islands	252	1, 071	135
AFRICA			
British Africa:			
West		376	152
South	1, 642	877	
Canary Islands	87	1, 140	
Egypt		479	
Liberia	6		
Portuguese Africa	1, 251	47	
Spanish Africa	701		
Total	790, 198	492, 879	205, 446
RECAPITULATION			
Europe	696, 102	364, 098	134, 657
North America	45, 756	97, 139	66, 089
South America	8, 533	4, 051	1, 692
Asia	2, 184	333	895
Oceania	33, 936	24, 339	1, 961
Africa	3, 687	2, 919	152

[2] In 1918 the practice was inaugurated of publishing customs figures for the calendar years instead of the fiscal years, as had prevailed previously. The following tables show the exports of fresh and cured salmon, by countries to which exported, for the calendar years 1919 to 1927, inclusive:

Exports, by countries receiving, of domestic fresh and cured salmon—Continued

DETAILS, CALENDAR YEARS 1919-1927

Country receiving	1919	1920	1921
EUROPE			
Belgium	$1,230	--------	--------
Greece	--------	$6,913	$504
Denmark	75,095	8,400	11,800
France	6,444	950	--------
Germany	--------	61	31,700
Iceland, and Faroe Islands	200	--------	--------
Netherlands	617	5,003	393
Norway	43,840	1,540	--------
Spain	16	--------	--------
Sweden	2,430	1,800	50
United Kingdom: England	251,730	118,916	66,431
Russia in Europe	--------	38	--------
NORTH AMERICA			
Bermuda	25	111	177
British Honduras	--------	30	80
Canada	421,498	191,710	321,276
Newfoundland and Labrador	--------	12	--------
Costa Rica	--------	32	37
Guatemala	96	20	--------
Honduras	5	8	8
Nicaragua	21	43	20
Panama	646	246	682
Salvador	26	222	13
Mexico	13,884	3,268	1,612
British West Indies:			
Barbados	4,000	--------	--------
Jamaica	108	102	416
Trinidad and Tobago	16	--------	58
Other British West Indies	15	92	378
Cuba	1,643	2,266	510
Dominican Republic	525	833	586
Dutch West Indies	110	273	72
French West Indies	255	--------	125
Haiti	38	145	117
Virgin Islands of United States	241	552	304
British Columbia and Yukon	--------	--------	--------
SOUTH AMERICA			
Argentina	--------	--------	585
Bolivia	2	15	--------
Brazil	2,194	105	--------
Chile	190	--------	--------
SOUTH AMERICA—cont.			
Colombia	$182	$1,826	$297
Ecuador	--------	10	--------
Dutch Guiana	238	52	--------
British Guiana	--------	24	--------
French Guiana	135	78	14
Peru	10	--------	--------
Venezuela	49	509	--------
ASIA			
China	286	53	26
Chosen	--------	11	--------
British India	--------	--------	645
British Straits Settlements	29	365	201
Other British East Indies	3	--------	--------
Dutch East Indies	749	1,785	310
French East Indies	5	--------	--------
Hong Kong	--------	3	--------
Japan	6,214	3,888	--------
Russia in Asia	67	--------	32
Siam	3	--------	--------
OCEANIA			
Australia	4,840	5,666	249
New Zealand	--------	145	--------
Other British Oceania	--------	12	--------
French Oceania	134	159	80
German Oceania	36	--------	--------
Philippine Islands	1,513	979	3,245
Other Oceania	--------	--------	76
AFRICA			
Belgian Congo	--------	--------	--------
British West Africa	381	75	67
British South Africa	--------	18	--------
Egypt	--------	--------	16
French Africa	450	--------	85
Total	842,464	359,364	443,277
RECAPITULATION			
Europe	381,602	143,621	110,878
North America	443,152	199,965	326,471
South America	3,000	2,619	896
Asia	7,356	6,105	1,214
Oceania	6,523	6,961	3,650
Africa	831	93	168

Exports, by countries receiving, of domestic fresh and cured salmon—Continued

Country receiving	1922		1923	
	Pounds	Value	Pounds	Value
Belgium			1,595	$418
Denmark	123,969	$53,324	63,138	19,359
France	16,265	2,160	29,000	5,700
Germany	305,883	42,865	56,255	5,745
Netherlands	22,538	4,963	110,185	24,106
Norway	204,020	49,697	183,825	43,698
Sweden			34,991	7,333
United Kingdom:				
England	484,826	90,721	1,539,671	240,177
Scotland	12,000	2,160		
NORTH AMERICA				
Quebec and Ontario	96,681	15,883	34,058	8,031
Bermuda	2,177	357	551	128
British Honduras			296	36
Canada, Prairie Provinces	3,351	1,049	3,042	950
Canada, Maritime Provinces	1,350	240	38,984	2,535
Costa Rica	1,380	122	200	34
Honduras	50	7	440	67
Nicaragua	70	22		
Panama	9,903	1,016	4,774	600
Salvador	25	13	49	19
Mexico	14,518	2,094	12,022	2,117
Jamaica	440	81	1,162	231
Trinidad and Tobago	1,065	75	138	50
Other British West Indies	808	103	506	76
Cuba	16,557	1,599	53,503	8,016
Dominican Republic	12,700	997	4,228	424
Dutch West Indies	1,043	117	1,401	164
Haiti			200	60
Virgin Islands of United States	2,170	139	1,730	179
British Columbia and Yukon	4,540,905	280,727	2,728,357	290,346
SOUTH AMERICA				
Argentina	14,557	3,989	17,299	6,845
Brazil			240	51
Chile			1,200	140
Colombia	1,168	83	1,060	133
Dutch Guiana	250	101	3,520	454
British Guiana			1,600	233
French Guiana			500	58
Peru	20	12		
Venezuela	8,630	790	16,232	1,627
ASIA				
China	3,379	426		
Java and Madura	1,195	375	66	20
British India			715	87
Hong Kong	12,150	785		
Japan	11,263	1,114	328,459	14,894
Palestine and Syria	960	115		
Russia in Asia	100	13		
OCEANIA				
Australia	9,915	2,917	600	150
New Zealand	100	13		
French Oceania	84	32	703	115
Philippine Islands	19,492	3,247	18,150	2,675
AFRICA				
British South Africa	50	20	1,650	207
Total	5,958,007	564,563	5,296,295	688,288
RECAPITULATION				
Europe	1,169,501	245,890	2,018,660	346,536
North America	4,705,193	304,641	2,885,641	314,063
South America	24,625	4,975	41,651	9,541
Asia	29,047	2,828	329,240	15,001
Oceania	29,591	6,209	19,453	2,940
Africa	50	20	1,650	207

Exports, by countries receiving, of domestic fresh and cured salmon—Continued

Country receiving	1924		1925	
	Pounds	Value	Pounds	Value
EUROPE				
Austria	1, 100	$156		
Belgium	1, 650	429	42, 970	$7, 077
Denmark	115, 890	31, 039	124, 575	39, 410
France	202, 700	44, 668	200, 200	43, 985
Germany	1, 122, 095	236, 828	1, 616, 515	286, 163
Greece	55, 780	6, 594	17, 500	1, 475
Netherlands	252, 039	48, 515	170, 425	34, 518
Norway	123, 950	27, 600	167, 865	48, 065
Rumania	5, 069	912		
Sweden	103, 800	11, 560	18, 050	2, 102
United Kingdom: England	1, 230, 082	230, 586	1, 324, 722	194, 387
NORTH AMERICA				
Canada	2, 009, 074	233, 013	1, 944, 288	150, 684
British Honduras	70	15	62	15
Costa Rica	500	51	200	31
Guatemala	600	60	156	18
Honduras	1, 270	127		
Nicaragua	60	6		
Panama	5, 602	759	9, 198	1, 403
Salvador	48	11		
Mexico	19, 376	2, 136	125, 465	8, 109
Newfoundland and Labrador	135	34		
Bermuda	14, 752	2, 195	2, 379	623
Barbados			60	18
Jamaica	425	55	2, 320	298
Other British West Indies	1, 056	153	1, 276	244
Cuba	5, 807	544	18, 531	2, 003
Dominican Republic	2, 430	341	1, 060	154
Dutch West Indies	1, 242	215	1, 020	142
Haiti	750	103		
Virgin Islands of United States	2, 196	300	2, 438	320
SOUTH AMERICA				
Argentina	14, 789	4, 621	12, 220	2, 834
Bolivia	1, 542	123		
Brazil			445	89
Chile	591	94		
Colombia			462	50
British Guiana	320	33		
Dutch Guiana			3, 000	409
French Guiana			350	50
Peru			100	14
Venezuela	6, 778	688	300	34
ASIA				
China	75	16	1, 484	217
Hong Kong	6, 680	204		
Japan	30	5	1, 820	260
Straits Settlements	8, 750	1, 884	26, 092	6, 391
OCEANIA				
Australia	30, 700	3, 102	3, 150	359
British Oceania			40	15
French Oceania	865	121	300	50
New Zealand	300	47		
Philippine Islands	108, 833	6, 481	15, 780	2, 573
Other Oceania			485	107
AFRICA				
British West Africa	3, 500	260		
Canary Islands			1, 786	301
Total	5, 463, 301	896, 684	5, 859, 089	834, 997
RECAPITULATION				
Europe	3, 214, 155	638, 887	3, 682, 822	657, 182
North America	2, 065, 393	240, 118	2, 108, 453	164, 062
South America	24, 020	5, 559	16, 877	3, 480
Asia	15, 535	2, 109	29, 396	6, 868
Oceania	140, 698	9, 751	19, 755	3, 104
Africa	3, 500	260	1, 786	301

Exports, by countries receiving, of domestic fresh and cured salmon—Continued

Country receiving	1926	
	Pounds	Value
EUROPE		
Belgium	122, 600	$20, 787
Denmark	54, 275	17, 100
France	74, 350	14, 170
Germany	1, 733, 162	361, 686
Italy	4, 000	720
Netherlands	448, 594	105, 125
Norway	60, 862	14, 247
Sweden	60, 285	10, 974
United Kingdom	1, 560, 879	279, 394
NORTH AMERICA		
Canada	856, 455	90, 712
British Honduras	210	28
Honduras	790	96
Panama	6, 060	937
Mexico	81, 657	5, 855
Newfoundland and Labrador	160	29
Bermuda	2, 812	603
Barbados	380	83
Jamaica	312	115
Trinidad and Tobago	70	17
Other British West Indies	338	84
Cuba	2, 725	565
Dominican Republic	2, 835	369
French West Indies	2, 498	505
Virgin Islands of United States	532	46
SOUTH AMERICA		
Argentina	5, 290	$1, 788
Colombia	2, 700	251
French Guiana	624	78
Peru	100	18
Venezuela	1, 245	180
ASIA		
China	2, 339	397
Hong Kong	1, 000	175
Japan	1, 160	155
Malaya	11, 160	2, 730
OCEANIA		
Australia	71, 400	10, 814
British Oceania	1, 630	403
French Oceania	100	12
New Zealand	600	102
Philippine Islands	8, 088	1, 462
Total	5, 184, 277	942, 812
RECAPITULATION		
Europe	4, 119, 007	824, 203
North America	957, 834	100, 044
South America	9, 959	2, 315
Asia	15, 659	3, 457
Oceania	81, 818	12, 793

Country receiving	1927	
	Pounds	Value
EUROPE		
Belgium	160, 200	$33, 280
Denmark	37, 198	9, 957
France	10, 000	1, 500
Germany	1, 799, 341	384, 526
Hungary	38, 775	8, 063
Netherlands	435, 201	99, 184
Norway	71, 975	20, 736
Sweden	222, 855	37, 567
United Kingdom	1, 567, 980	256, 935
NORTH AMERICA		
Canada	945, 017	104, 849
Costa Rica	7, 400	928
Guatemala	10	2
Nicaragua	4, 070	378
Panama	7, 500	817
Salvador	120	24
Mexico	4, 415	773
Bermuda	1, 765	446
Barbados	550	149
Jamaica	315	102
Other British West Indies	287	42
Cuba	6, 470	1, 347
Dominican Republic	5, 736	666
Netherland West Indies	3, 466	805
Haiti, Republic of	1, 170	181
Virgin Islands of United States	1, 196	163
SOUTH AMERICA		
Argentina	9, 093	$4, 061
Colombia	2, 160	289
Peru	2, 980	384
Venezuela	3, 460	469
ASIA		
British India	336	56
British Malaya	9, 745	2, 207
China	3, 138	453
Netherland East Indies	110	12
Hong Kong	3, 825	585
Japan	170	22
OCEANIA		
Australia	53, 304	7, 575
British Oceania	200	35
French Oceania	1, 050	216
New Zealand	600	116
Philippine Islands	12, 359	2, 270
Total	5, 435, 542	982, 170
RECAPITULATION		
Europe	4, 343, 525	851, 748
North America	989, 487	111, 672
South America	17, 693	5, 203
Asia	17, 324	3, 335
Oceania	67, 513	10, 212

Exports, by countries receiving, of domestic pickled salmon, calendar years 1918 to 1927 [1]

Country receiving	1918		1919	
	Pounds	Value	Pounds	Value
EUROPE				
Azores and Madeira Islands			400	$62
Belgium			200	35
Denmark			2,008,800	466,359
Germany			461,400	41,538
Greece			21,800	3,879
Netherlands			54,000	15,995
Norway			502,800	123,069
Spain			200	29
Sweden			435,600	105,010
United Kingdom:				
England	83,800	$17,800	442,000	124,152
Scotland			20,200	2,830
NORTH AMERICA				
Bermuda			7,400	662
British Honduras			200	20
Canada	13,200	1,300	54,400	5,031
Central American States:				
Costa Rica			600	66
Guatemala	1,000	138	1,000	199
Honduras	200	6		
Nicaragua			600	59
Panama	6,200	817	5,600	846
Mexico	1,000	104	400	36
West Indies:				
British—				
Barbados	1,400	176	60,200	11,380
Jamaica	200	17	3,600	390
Trinidad and Tobago	1,200	115	131,800	18,148
Other British	600	59	1,800	243
Cuba	3,400	452	6,200	1,008
Danish	3,600	350		
Dominican Republic	10,800	1,180	7,000	1,004
Dutch	400	20	2,600	213
French	400	46	3,800	547
Haiti	4,800	497	4,000	652
Virgin Islands of United States			4,000	454
SOUTH AMERICA				
Colombia	200	20	400	36
Guiana:				
British	2,800	369	2,000	270
Dutch	3,000	386	20,200	2,726
French	7,000	865	7,000	1,186
Peru			600	72
Venezuela	400	42	200	50
ASIA				
China	1,800	210	600	86
Japan			18,600	1,864
OCEANIA				
British:				
Australia	211,600	23,704	147,200	16,292
New Zealand	200	28		
Other British	400	35	600	70
French	8,800	937	5,800	692
German	15,000	1,645	3,800	413
Philippine Islands	600	63		
AFRICA				
British South Africa			200	32
Liberia	400	20	1,400	69
Total	384,400	51,401	4,451,200	947,694
RECAPITULATION				
Europe	83,800	17,800	3,947,400	882,958
North America	48,400	5,277	295,200	8,84,340
South America	13,400	1,682	30,400	740
Asia	1,800	210	19,200	1,950
Oceania	236,600	26,412	157,400	17,467
Africa	400	20	1,600	101

[1] Included in "All others" in previous years.

Exports, by countries receiving, of domestic pickled salmon, calendar years 1918 to 1927—Continued

Country receiving	1920		1921	
	Pounds	Value	Pounds	Value
EUROPE				
Belgium	2,400	$570		
Denmark	1,155,600	298,586	1,195,800	$304,724
Germany	1,319,400	318,406	2,436,400	528,105
Greece	61,800	9,640	12,000	700
Italy	35,400	8,231	15,400	4,660
Malta, Gozo, etc	32,000	3,925	9,000	875
Netherlands	266,200	59,853	361,000	85,796
Norway	1,068,000	268,221	694,000	208,822
Rumania			1,400	275
Spain			400	80
Sweden	873,400	210,466	290,000	82,215
United Kingdom: England	658,400	193,263	504,200	137,521
NORTH AMERICA				
Canada	24,000	2,317	73,600	11,767
Costa Rica	2,800	295	2,400	219
Guatemala	600	41	1,200	110
Honduras	200	22	800	149
Panama	7,400	1,134	9,400	1,044
Mexico	1,800	188	1,200	185
Newfoundland and Labrador			1,000	52
Barbados	18,000	2,722	31,200	4,405
Jamaica	5,000	589	15,400	1,370
Trinidad and Tobago	14,200	2,308	13,000	1,810
Other British West Indies	200	20	7,200	924
Cuba	16,800	1,967	9,000	771
Dominican Republic	18,600	2,390	4,000	334
Dutch West Indies	9,000	1,265	8,200	798
French West Indies			4,600	586
Haiti	6,400	826	8,200	627
Virgin Islands of United States	10,200	1,177	14,200	1,486
SOUTH AMERICA				
Colombia			3,200	389
British Guiana			3,400	390
Dutch Guiana	21,000	2,699	2,200	238
French Guiana	2,000	173		
Venezuela	200	36		
ASIA				
China	5,400	432	200	15
Hong Kong	400	35		
Japan	1,000	185	1,000	91
Turkey in Asia			1,200	250
OCEANIA				
Australia	63,200	7,602	140,600	16,362
New Zealand	12,400	1,308	1,600	232
Other British Oceania	600	60		
French Oceania	5,200	650	2,800	295
Other Oceania	2,400	254	3,000	283
Philippine Islands			1,000	38
AFRICA				
British West Africa	2,000	315		
British East Africa	3,000	420		
French Africa	600	90		
Total	5,727,200	1,402,681	5,884,400	1,398,993
RECAPITULATION				
Europe	5,472,600	1,371,161	5,519,600	1,353,773
North America	135,200	17,261	204,600	26,637
South America	23,200	2,908	8,800	1,017
Asia	6,800	652	2,400	356
Oceania	83,800	9,874	149,000	17,210
Africa	5,600	825		

Exports, by countries receiving, of domestic pickled salmon, calendar years 1918 to 1927—Continued

Country receiving	1922		1923	
	Pounds	Value	Pounds	Value
EUROPE				
Finland			200	$16
Denmark	654, 600	$193, 063	436, 400	153, 360
Germany	1, 399, 000	293, 967	481, 400	116, 569
Netherlands	54, 400	13, 559	264, 200	53, 519
Norway	383, 000	113, 212	470, 600	131, 039
Sweden	234, 600	65, 024	260, 600	71, 449
United Kingdom: England	569, 600	154, 647	363, 600	103, 140
NORTH AMERICA				
Bermuda	600	49		
British Columbia and Yukon	178, 400	17, 039	271, 600	67, 806
Canada, Maritime Provinces	200	15	400	40
Quebec and Ontario	600	65	2, 800	584
Canada, Prairie Provinces	52, 000	6, 258	400	21
Costa Rica	2, 800	198	2, 800	256
Guatemala	800	66		
Honduras	200	21	200	19
Panama	6, 800	650	3, 800	421
Mexico	2, 200	277	200	9
British West Indies:				
Barbados	8, 600	837		
Jamaica			1, 000	84
Trinidad and Tobago	10, 000	675		
Other British			200	18
Cuba	1, 800	168	1, 400	135
Dominican Republic	1, 400	123	1, 800	170
Dutch West Indies	3, 000	281	3, 200	292
French West Indies	800	67		
Haiti	9, 200	727	7, 600	652
Virgin Islands of United States	3, 400	273	1, 600	144
SOUTH AMERICA				
Argentina			200	33
Colombia	200	12		
British Guiana	800	60	200	28
Dutch Guiana	1, 000	80	1, 200	108
French Guiana			200	27
Venezuela	3, 000	288	200	24
ASIA				
China	200	18	200	16
Hong Kong			200	25
Japan	200	20	124, 200	10, 491
OCEANIA				
British Oceania			600	54
Australia	253, 400	25, 478	201, 000	20, 032
New Zealand	3, 800	331	400	69
Other British Oceania			2, 000	129
French Oceania	6, 600	477	6, 400	638
Other Oceania	5, 800	472		
Philippine Islands	200	32		
AFRICA				
British West Africa	400	40		
Liberia	200	30	400	19
Total	3, 853, 800	888, 599	2, 913, 400	731, 436
RECAPITULATION				
Europe	3, 295, 200	833, 472	2, 277, 000	629, 092
North America	282, 800	27, 789	299, 000	70, 651
South America	5, 000	440	2, 000	220
Asia	400	38	124, 600	10, 532
Oceania	269, 800	26, 790	210, 400	20, 922
Africa	600	70	400	19

Exports, by countries receiving, of domestic pickled salmon, calendar years 1918 to 1927—Continued

Country receiving	1924 Pounds	1924 Value	1925 Pounds	1925 Value
EUROPE				
Denmark	625,400	$188,126	554,200	$162,268
France			30,000	7,800
Germany	2,395,800	571,298	2,853,000	763,221
Greece	2,400	690		
Netherlands	235,600	64,091	234,600	63,253
Norway	360,200	112,596	321,200	97,859
Sweden	402,200	99,562	509,800	143,837
United Kingdom: England	331,600	97,761	153,600	43,373
NORTH AMERICA				
British Honduras			200	18
Canada	723,800	122,775	28,000	4,438
Costa Rica	200	25	600	76
Guatemala	200	24	400	52
Honduras	200	33		
Nicaragua			200	24
Panama	31,000	7,530	2,800	448
Mexico	1,000	77	600	45
Miquelon and St. Pierre Islands			200	19
Bermuda			200	50
Other British West Indies	400	36	400	43
Trinidad and Tobago	200	27		
Cuba	27,600	2,739	2,600	357
Dominican Republic	600	59	400	52
Dutch West Indies	3,400	311	3,600	457
French West Indies	600	58	400	58
Haiti	3,800	450	400	43
Virgin Islands of United States	2,200	195	1,400	178
SOUTH AMERICA				
British Guiana	200	25		
Dutch Guiana	2,000	200	400	80
French Guiana	800	84	2,000	244
Venezuela	200	32		
ASIA				
Japan			200	18
OCEANIA				
Australia	204,200	28,350	64,000	12,647
New Zealand	800	122	400	80
French Oceania	7,800	982	4,000	569
Other Oceania	1,000	113	3,800	418
Philippine Islands			200	32
Total	5,365,400	1,298,371	4,773,800	1,302,057
RECAPITULATION				
Europe	4,353,200	1,134,124	4,656,400	1,281,611
North America	795,200	134,339	42,400	6,358
South America	3,200	341	2,400	324
Asia			200	18
Oceania	213,800	29,567	72,400	13,746

Country receiving	1926 Pounds	1926 Value
EUROPE		
Belgium	27,200	$7,567
Austria	7,200	1,800
Denmark	262,600	79,678
Germany	1,852,200	436,892
Netherlands	192,400	49,498
Norway	183,800	55,520
Sweden	596,400	119,701
United Kingdom	123,400	35,103
Italy	1,200	125
NORTH AMERICA		
Canada	6,800	1,342
Costa Rica	1,400	184
Guatemala	200	23
Panama	4,000	684
Mexico	200	20
Bermuda	1,400	209
Other British West Indies	200	17
Cuba	6,000	678
Dominican Republic	3,000	285
Dutch West Indies	2,600	383
Haiti	600	104
Virgin Islands of United States	2,400	330
SOUTH AMERICA		
Dutch Guiana	2,000	320
Colombia	200	32
ASIA		
Hong Kong	200	20
OCEANIA		
French Oceania	1,000	202
Australia	75,600	12,092
British Oceania	2,000	242
Total	3,356,200	803,051
RECAPITULATION		
Europe	3,246,400	785,884
North America	28,800	4,259
South America	2,200	352
Asia	200	20
Oceania	78,600	12,536

Exports, by countries receiving, of domestic pickled salmon, calendar years 1918 to 1927—Continued

Country receiving	1927 Pounds	1927 Value	Country receiving	1927 Pounds	1927 Value
EUROPE			OCEANIA		
Denmark	295,400	$88,196	Australia	57,400	$9,626
Germany	1,853,800	475,486	British Oceania	600	60
Netherlands	187,400	49,454	French Oceania	200	14
Norway	196,400	67,316	New Zealand	4,400	474
Sweden	230,600	64,567			
United Kingdom	77,600	24,527	AFRICA		
NORTH AMERICA			British South Africa	8,200	2,888
Canada	9,600	1,594	Total	2,947,400	787,371
Costa Rica	1,000	66			
Panama	3,600	480	RECAPITULATION		
Bermuda	200	51			
Jamaica	200	39	Europe	2,841,200	769,546
Other British West Indies	1,200	125	North America	34,400	4,361
Cuba	600	85	South America	1,000	402
Dominican Republic	1,400	187	Oceania	62,600	10,174
Netherland West Indies	12,800	1,405	Africa	8,200	2,888
French West Indies	600	65			
Virgin Islands of United States	3,200	264			
SOUTH AMERICA					
Argentina	800	386			
Venezuela	200	16			

The following table gives a summary, by customs districts, of the exports of domestic fresh and cured salmon from 1900 to 1915, inclusive, and a detailed statement of the same for the years 1916 to 1927, inclusive. The greater part of the shipments pass through the New York City customs district.

Exports, by customs districts, of domestic pickled, fresh, etc., salmon

SUMMARY, FISCAL YEARS 1900 TO 1915 [1]

Customs district from which exported	1900	1901	1902	1903	1904	1905	1906
Atlantic ports	$346,924	$330,890	$503,439	$767,397	$1,103,034	$1,757,832	$1,781,476
Gulf ports		5	143	30	124	159	14
Mexican border ports	1,192	535	1,857	1,227	1,160	997	788
Pacific ports	185,644	92,698	188,177	99,018	56,167	66,772	139,606
Northern border and Lake ports	1,516	2,610	819	1,680	3,004	6,895	5,580

Customs district from which exported	1907	1908	1909	1910	1911	1912
Atlantic ports	$1,797,411	$1,590,778	$1,230,542	$1,479,656	$1,514,599	$1,586,319
Gulf ports	276	7,226	49	74	1,542	
Mexican border ports	424	167	25	202	18	202
Pacific ports	73,927	44,313	50,834	50,521	46,167	33,190
Northern border and Lake ports	6,705	5,560	7,110	2,187	10,813	10,440

Customs district from which exported	1913	1914	1915	Customs district from which exported	1913	1914	1915
New York	$2,060,068	$2,067,366	$1,377,840	San Francisco	$26,030	$29,880	$28,777
Alaska	20,995	16,932	6,630	All other districts	8,119	21,418	9,592
Puget Sound	7,354	59,713	2,020				

[1] A more detailed statement for 1900 to 1912 may be found in Pacific Salmon Fisheries, by John N. Cobb, Appendix III, Report U. S. Commissioner of Fisheries, 1916, pp. 202-203. Washington, 1917.

Exports, by customs districts, of domestic pickled, fresh, etc., salmon—Continued

DETAILS, FISCAL YEARS 1916 TO 1918

Customs district from which exported	1916	1917	1918	Customs district from which exported	1916	1917	1918
Maine and New Hampshire	$16	$22,480	$37	Alaska	$5,203	$29,348	$14,529
Massachusetts	2,925	14,764	32,002	Hawaii	16	15	7
New York	732,782	360,348	106,636	San Francisco	33,648	23,804	6,907
Porto Rico	47	635	57	Southern California	80	255	191
Florida	60		210	Washington	1,155	4,779	19,825
Mobile	48	5	5	Buffalo	394	2,939	6,450
New Orleans	610	166	408	Dakota	706	2,233	1,942
Sabine	33		950	Duluth and Superior	13	42	251
Arizona	1,736	374	501	Michigan	8,845	12,695	11,910
Eagle Pass		454		Montana and Idaho		5,567	49
El Paso		276	24	St. Lawrence	1,300	7,167	1,258
San Antonio			1,123	Vermont	565	4,433	174
Laredo	16	100		Total	790,198	492,879	205,446

Exports, by customs districts, of domestic pickled salmon, 1918 to 1927

Customs district from which exported	1918		1919		1920	
	Pounds	Value	Pounds	Value	Pounds	Value
Maine and New Hampshire			24,000	$2,220		
Massachusetts			400	65		
New York	131,400	$23,346	4,208,200	919,375	5,596,000	$1,387,502
Porto Rico	200	23			4,800	739
Philadelphia			8,800	3,500		
New Orleans	400	39	1,400	163	600	41
Alaska	8,000	770	800	100	1,000	77
San Francisco	237,000	26,443	159,400	17,724	85,200	10,534
Southern California	600	58	400	36		
Washington	4,000	458	20,000	2,017	38,400	3,639
Dakota	1,200	91	25,000	2,112	600	81
Duluth and Superior	400	60				
Michigan	600	53	800	168		
Montana and Idaho			200	34		
St. Lawrence	600	60	1,800	180		
San Antonio					600	68
Total	384,400	51,401	4,451,200	947,694	5,727,200	1,402,681

Customs district from which exported	1921		1922		1923	
	Pounds	Value	Pounds	Value	Pounds	Value
Buffalo			200	$21	2,400	$516
Massachusetts	1,000	$52				
New York	4,179,600	1,144,743	2,185,400	600,743	1,635,000	495,709
Philadelphia	1,800	450				
Maryland	5,000	1,150	2,000	395		
Porto Rico			1,200	74	800	66
New Orleans	2,600	348	1,000	87	17,200	6,216
Arizona			1,800	255		
San Antonio			400	22		
Alaska	69,000	11,304	178,000	16,978	271,600	67,806
San Francisco	334,600	57,959	850,600	165,150	498,600	82,412
Oregon	421,600	104,091	371,400	60,964	283,600	52,198
Washington	865,200	78,460	209,800	37,628	203,000	26,384
Montana and Idaho					200	10
Michigan					600	88
Dakota	4,000	436	52,000	6,258	200	11
St. Lawrence			200	24	200	20
Total	5,884,400	1,398,993	3,854,000	888,599	2,913,400	731,436

Exports, by customs districts, of domestic pickled salmon, 1918 to 1927—Continued

Customs district from which exported	1924		1925		1926	
	Pounds	Value	Pounds	Value	Pounds	Value
Maryland	5, 600	$1, 398				
Buffalo	10, 800	2, 777	10, 600	$1, 969	2, 000	$496
New York	3, 942, 000	1, 033, 183	3, 906, 200	1, 078, 093	2, 389, 400	599, 830
Philadelphia					11, 000	1, 250
Porto Rico	400	36	400	26	2, 000	253
New Orleans	2, 000	258	1, 400	239	3, 200	551
El Paso					200	20
Alaska	711, 000	119, 778	3, 400	482	3, 800	479
San Francisco	306, 800	45, 631	318, 800	61, 878	278, 200	54, 560
Los Angeles			200	15		
Florida					4, 000	379
Oregon	364, 800	90, 667	488, 600	148, 912	310, 000	93, 317
Washington	19, 800	4, 458	43, 400	10, 278	351, 400	51, 549
Michigan			200	53	800	305
Dakota	200	28				
Duluth and Superior			200	60		
Vermont	400	40				
St. Lawrence	800	77	400	52	200	62
San Antonio	800	40				
Total	5, 365, 400	1, 298, 371	4, 773, 800	1, 302, 057	3, 356, 200	803, 051

Customs district from which exported	1927		Customs district from which exported	1927	
	Pounds	Value		Pounds	Value
St. Lawrence	600	$150	Alaska	6, 400	$809
Buffalo	1, 600	338	Michigan	1, 000	297
New York	2, 328, 200	636, 046	Porto Rico	3, 400	297
San Francisco	264, 600	64, 184			
Oregon	341, 600	85, 250	Total	2, 947, 400	787, 371

Exports of all other salmon, by customs districts, calendar years 1919–1927

Customs district	1919	1920	1921	1922		1923	
				Pounds	Value	Pounds	Value
Maine and New Hampshire	$72, 305	$26		198	$41		
Vermont	2, 831	1, 370	$152	10, 720	1, 419	3, 850	$496
Massachusetts	18, 986	80		1, 114	172	77, 871	9, 428
St. Lawrence	29, 252	4, 299	4, 922	32, 705	6, 770	20, 791	5, 537
Buffalo	5, 964	5, 692	5, 978	28, 377	6, 057	7, 442	1, 579
New York	218, 204	135, 415	63, 574	433, 716	114, 035	430, 949	88, 271
Philadelphia	44, 625		38			115	40
Georgia		770					
Florida	4	58	107	5, 482	528	360	60
Mobile			74			186	24
New Orleans	4, 049	400	35	530	57	1, 030	137
Sabine	29	1, 161	288	1, 420	212		
Galveston		487	125				
San Antonio	13, 365	176	834	2, 301	405	7, 985	1, 467
El Paso	5		19	180	30	102	56
Arizona	65	61	170	680	60	225	50
San Diego	315	430	106	4, 411	869		
Los Angeles		906	11			3, 230	486
San Francisco	41, 046	2, 655	5, 104	41, 640	6, 631	95, 435	15, 328
Oregon		1, 000	25, 035	592, 861	102, 212	1, 164, 210	191, 469
Washington	13, 861	23, 195	39, 652	282, 117	46, 089	712, 381	78, 760
Alaska	347, 068	170, 518	294, 155	4, 515, 658	277, 854	2, 727, 449	290, 162
Hawaii		12	12	20	3		
Montana and Idaho	12, 283	15		244	33	640	115
Dakota	4, 250	5, 979	2, 432	2, 623	877	2, 433	844
Duluth and Superior	44			384	110		
Michigan	13, 591	4, 429	399	300	64	38, 975	3, 917
Ohio	123						
Porto Rico	199	230	55	326	35	636	62
Total	842, 464	359, 364	443, 277	5, 958, 007	564, 563	5, 296, 295	688, 288

Exports of all other salmon, by customs districts, calendar years 1919–1927—Con.

Customs district	1924		1925		1926		1927	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Maine and New Hampshire					160	$29		
Vermont	1,300	$117	200	$46	1,000	85	33	$15
Massachusetts	2,385	394	2,262	383				
St. Lawrence	19,732	4,864	22,603	5,188	9,356	2,860	16,927	5,054
Buffalo	6,590	1,667	5,729	1,654	15,542	3,981	4,074	1,474
New York	1,551,778	325,025	1,196,681	270,852	1,063,373	223,191	804,940	143,582
Philadelphia							825	50
Florida			520	81	142	37	70	14
Mobile	600	60			210	28		
New Orleans	4,372	259	162	35	180	36		
San Antonio	12,417	1,262	121,964	7,513	79,288	5,560	1,820	448
El Paso	552	100	254	62	20	11	89	21
Arizona			285	40			120	12
Los Angeles	99,735	5,253	2,851	477	2,349	284	2,210	264
San Francisco	74,053	9,513	82,492	15,031	206,550	27,986	184,776	39,644
Oregon	1,007,896	190,188	1,025,589	181,935	2,164,319	454,077	1,463,575	334,569
Washington	706,013	132,307	1,577,510	219,398	855,119	152,220	2,053,282	361,394
Alaska	1,968,996	224,132	1,769,513	126,835	782,368	71,511	889,425	91,567
Montana and Idaho			85	11				
Dakota	1,565	462	475	105	217	69	661	64
Duluth and Superior	124	40					176	29
Michigan	4,923	994	48,206	5,144	3,552	801	11,343	3,806
Porto Rico	270	47	1,708	207	532	46	1,196	163
Total	5,463,301	896,684	5,859,089	834,997	5,184,277	942,812	5,435,542	982,170

IMPORTS OF FRESH SALMON [41]

For some years it was the custom of the canneries on Puget Sound, when fish were scarce on the American side and abundant on the Canadian side, to import fresh salmon to fill out the domestic supply and the Canadian canneries would do the same when the conditions were reversed. In 1904 the Canadian Government prohibited the export of fresh sockeye salmon to Puget Sound for packing purposes, and in 1910 an effort was made to have Congress retaliate by enacting a similar law for this side of the line, but the bill failed of passage.

The table below shows the yearly imports of fresh salmon from British Columbia:

Imports of fresh salmon from British Columbia, Canada, for a series of years [1]

Year	Pounds	Value	Year	Pounds	Value	Year	Pounds	Value
1890	4,660	$241	1897	93,454	$2,681	1904	40,610	$1,025
1891	4,950	170	1898	11,580	278	1905	1,015	35
1892	6,288	301	1899	58,002	4,101	1906	3,457,738	64,408
1893	64,811	3,639	1900	19,404	855	1907	113,224	4,131
1894	3,872	219	1901	27,072	2,050	1908	8,880	795
1895	14,000	1,403	1902	22,353	739	1909	41,073	2,346
1896	11,799	419	1903	6,860	343	1910	198,251	10,116

[1] After 1909 all imports of fresh salmon are listed under "Fish, fresh."

After 1911 the imports of fresh salmon from both coasts of Canada and from Newfoundland were lumped together, and are shown in the table below. Generally, about nine-tenths of this salmon came from the Province of British Columbia in Canada.

[41] The tables include salmon—fresh, frozen, and packed in ice.

Imports of fresh salmon from British Columbia, Canada, for a series of years—Continued

FISCAL YEAR

June 30—	Pounds	Value	June 30—	Pounds	Value	June 30—	Pounds	Value
1911	1, 122, 286	$114, 123	1914	3, 262, 828	$245, 791	1917	19, 769, 660	$599, 442
1912	1, 520, 687	135, 416	1915	10, 676, 296	383, 697	1918	14, 408, 294	957, 169
1913	2, 089, 781	180, 513	1916	24, 026, 481	501, 115	1919	15, 571, 451	928, 552

CALENDAR YEAR

Dec. 31—	Pounds	Value	Dec. 31—	Pounds	Value	Dec. 31—	Pounds	Value
1918	13, 085, 998	$631, 119	1922	10, 490, 728	$1, 165, 291	1926	5, 441, 629	$645, 609
1919	13, 745, 498	825, 803	1923	7, 644, 640	892, 071	1927	6, 052, 871	668, 982
1920	5, 645, 306	663, 552	1924	8, 606, 343	970, 572			
1921	11, 495, 880	1, 119, 719	1925	6, 548, 711	749, 578			

The following table shows, by customs districts, the imports of fresh salmon during the calendar year 1927. Included therein are 8,508 pounds, valued at $841, which were imported from Japan, in addition to the imports from Canada.

Imports of fresh salmon, by customs districts, calendar year 1927

Customs district	Pounds	Value	Customs district	Pounds	Value
Maine and New Hampshire	346, 377	$64, 806	Hawaii	6, 420	$746
Vermont	301, 134	57, 228	Montana and Idaho	3, 426	578
Massachusetts	644, 450	85, 507	Dakota	152, 810	16, 249
St. Lawrence	465, 681	77, 709	Duluth and Superior	35, 544	8, 785
Buffalo	214, 036	31, 310	Wisconsin	25, 050	1, 754
New York	68, 884	11, 345	Michigan	2, 250	259
Washington	3, 794, 783	313, 440			
Alaska	534	107	Total	6, 061, 379	669, 823

During the calendar year 1928 imports of fresh and frozen salmon amounted to 6,221,101 pounds, valued at $711,462.

IMPORTS OF CURED SALMON

Below are shown the imports into this country of foreign-cured salmon, the product of the Pacific salmon fisheries, from 1886 to 1909, inclusive.

Imports of foreign cured or pickled Pacific salmon, 1886 to 1909 [1]

Year	British Columbia		Japan		Hong Kong		Russia, Asiatic		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1886	5, 600	$224							5, 600	$224
1887	200	4							200	4
1888	86, 000	4, 031							86, 000	4, 031
1889	18, 200	860							18, 200	860
1890	600	36							600	36
1891	200	5							200	5
1893	5, 478	291							5, 478	291
1894	149, 410	17, 592			1, 200	$29	11, 875	$298	162, 485	17, 919
1895	6, 550	250			600	13			7, 150	263
1896	6, 530	474							6, 530	474
1897	6, 890	156							6, 890	156
1898	4, 145	188			30	2	9, 870	266	14, 045	456
1899	15, 875	1, 554							[2] 16, 032	[2] 1, 560
1900	162, 558	11, 061	600	$41					163, 158	11, 102
1901	165, 243	11, 225							165, 243	11, 225
1902	175, 411	13, 794	606	28					176, 017	13, 822
1903	161, 549	11, 756	360	18					161, 909	11, 774
1904	282, 210	23, 319	1, 400	52					283, 610	23, 371
1905	282, 027	25, 584	3, 015	133					285, 042	25, 717
1906	35, 475	1, 730	5, 510	175					40, 985	1, 905
1907	6, 393	322	680	31					7, 073	353
1908	13, 230	631	4, 185	174					17, 415	805
1909	30, 710	1, 523	3, 537	148					34, 247	1, 617
1910	111, 645	5, 505								

[1] After 1909 all imports of salmon, pickled or salted, are included under "All other cured or preserved."
[2] Includes 157 pounds, valued at $6, from China.

Since 1910 all imports of cured or pickled salmon have been lumped together and it has been impossible to distinguish the imports of Pacific salmon from those imported from Atlantic districts. The table below shows the total imports, almost all of which comprise salmon from the Province of British Columbia in the Dominion of Canada.

FISCAL YEAR

June 30—	Pounds	Value	June 30—	Pounds	Value	June 30—	Pounds	Value
1911	695, 878	$62, 769	1914	1, 114, 927	$84, 503	1917	945, 394	$81, 776
1912	417, 938	33, 901	1915	1, 162, 341	104, 451	1918	739, 759	74, 042
1913	344, 530	28, 650	1916	1, 010, 844	70, 837	1919	859, 276	117, 352

CALENDAR YEAR [1]

Dec. 31—	Pounds	Value	Dec. 31—	Pounds	Value	Dec. 31—	Pounds	Value
1923	1, 658, 666	$283, 477	1925	2, 652, 138	$422, 452	1927	2, 440, 939	$375, 900
1924	2, 678, 908	391, 470	1926	4, 496, 976	658, 605			

[1] For the years 1920 to 1922, inclusive, imports of salmon are not shown separately from other cured fish.

EXPORTS OF CANADIAN CANNED SALMON

Exports of canned salmon from Canada, 1916–1927

[Fiscal year ended Mar. 31]

Destination	1916	1917	1918	1919
	Pounds	*Pounds*	*Pounds*	*Pounds*
Australia	4,789,094	3,365,149	2,236,742	3,750,194
Barbados				1,642
Bermuda	11,480	10,934	9,132	25,884
Bolivia		9,600		120,000
British Guiana		48		96
British India	298,200	101,344	2,400	55,950
British South Africa	52,800			48,000
British West Indies	28,643	116,112	48,238	
Chile		14,400		614,016
China	11,976	1,440	101	2,540
Cuba				1,048,800
Dutch East Indies	343,632	319,344	47,768	28,800
Ecuador				2,400
Fiji Islands	928,752	860,400	736,616	354,196
France	3,905,461	5,521,100	13,529,569	2,869,658
French Oceania		14,400	48,000	
Greenland, Iceland, etc			200	
Hong Kong	18,240		7,300	15,550
Italy		60	3,109,694	5,454,670
Jamaica				576
Japan				192
Newfoundland			120	48,000
New Zealand	1,338,050	1,339,282	1,689,652	1,623,496
Other British East Indies				36,000
Other British Oceania	91,056	105,360	6,000	12,000
Other British West Indies				8,646
Panama		4,700		
Peru		21,600		
Russia in Europe				48,600
Siam	14,400	124,848		24,096
St. Pierre and Miquelon	2,394	1,351	1,869	4,784
Straits Settlements	2,064,736	1,060,018	292,800	412,810
Switzerland	192			
Trinidad and Tobago				240
United Kingdom	35,225,051	34,772,879	21,117,314	29,265,108
United States	18,725	567,758	893,639	1,936,753
Total	49,142,882	48,332,127	43,777,154	47,813,697

Destination	1920	1921	1922	1923
	Pounds	*Pounds*	*Pounds*	*Pounds*
Aden				
Argentina		3,400		
Australia	2,198,800	2,285,900	3,739,900	2,993,800
Austria-Hungary	2,000			
Barbados	59,700	94,700	66,400	75,000
Belgian Congo				
Belgium	713,600	127,100	1,090,000	1,144,600
Bermuda	5,400	19,800	6,500	51,600
Bolivia				45,600
Brazil		1,300		
British:				
East Africa				
Guiana	3,700	41,600	22,200	80,600
Honduras				
India				
South Africa	275,100	269,300	117,500	52,800
Straits Settlements	2,551,400	2,193,000	1,261,100	470,500
West Africa	52,800	48,000	3,600	
Canary Islands				
Ceylon	1,300			12,200
Chile	1,451,000	488,200		201,600
China	6,000	12,300	8,900	2,800
Colombia				
Costa Rica		1,000	28,700	
Cuba	334,800	177,100	2,400	
Czechoslovakia				
Denmark		100	24,000	39,000
Dutch:				
East Indies	140,200	391,500	378,200	84,000
West Indies				200
Guiana	500	44,400	13,100	37,700

Exports of canned salmon from Canada, 1916–1927—Continued

Destination	1920	1921	1922	1923
	Pounds	*Pounds*	*Pounds*	*Pounds*
Ecuador	142,600	75,100		45,600
Egypt	23,400	55,100	255,000	52,800
Fiji Islands	329,700	808,800	424,500	544,700
Finland		200		
France	11,986,800	3,541,100	17,422,000	16,386,100
French:				
Africa		6,700	12,700	11,100
East Indies				
Guiana			500	
Oceania	15,700	26,400		2,900
West Indies				
Gambia				
Germany		48,000		
Gibraltar				
Gold Coast		48,000	9,600	
Greece	488,800	48,000	342,000	
Guatemala				
Haiti				
Hawaii		1,200		
Holland	1,900	52,400	470,000	319,900
Hong Kong	44,600	14,500	100	9,300
Irish Free State				
Iraq (Mesopotamia)				
Italy	413,100	48,500		341,200
Jamaica	124,400	92,100	13,900	113,900
Japan	200	2,900	100	1,600
Liberia				
Malta	22,600	4,900	29,800	72,000
Mexico	589,000	125,500	6,700	
Morocco				
Netherlands				
Newfoundland	400	100		
New Zealand	1,392,600	838,900	839,800	1,650,900
Nicaragua				3,800
Nigeria		10,100	26,400	
Norway	100	5,000	900	4,800
Other British:				
East Indies		1,200	16,600	
Oceania	68,100	46,200	119,900	102,700
West Indies	3,600	26,400	6,400	30,300
Palestine				
Panama	32,600		12,300	
Peru	187,000	162,200	2,400	
Philippine Islands	144,000	38,500		
Porto Rico	215,000	100		
Portuguese:				
Africa		3,000		
Asia				
Salvador				1,000
San Domingo			1,900	
Siam	19,300	81,600	163,300	96,000
Sierra Leone		2,400	4,800	
Spain		16,700		
Spanish Africa				
St. Pierre and Miquelon	4,200	1,800		900
Sweden	10,300	8,200	23,300	12,000
Switzerland	2,800	2,400	48,300	52,900
Syria				
Trinidad and Tobago		101,800	116,000	124,800
Turkey	14,400	1,900		
United Kingdom	31,045,100	16,865,700	15,900,400	6,228,400
United States	6,224,800	1,228,500	544,900	592,000
United States of Colombia		15,600		800
Uruguay				
Venezuela		96,000		
Virgin Islands of United States				
Yugoslavia				
Total	61,528,800	30,857,800	43,623,900	32,196,900

Exports of canned salmon from Canada, 1916–1927—Continued

Destination	1924	1925	1926	1927
	Pounds	*Pounds*	*Pounds*	*Pounds*
Aden	-----	-----	8, 400	2, 400
Argentina	2, 400	-----	2, 400	9, 600
Australia	5, 731, 400	7, 608, 500	9, 223, 600	10, 528, 800
Austria-Hungary	-----	-----	-----	-----
Barbados	82, 800	144, 500	95, 300	197, 300
Belgian Congo	-----	-----	20, 100	29, 700
Belgium	4, 105, 000	2, 752, 100	2, 318, 800	2, 003, 100
Bermuda	28, 700	49, 700	50, 600	75, 700
Bolivia	208, 000	26, 400	69, 200	28, 800
Brazil	5, 300	-----	5, 600	1, 900
British:				
East Africa	-----	1, 200	39, 100	34, 200
Guiana	93, 500	225, 700	139, 000	133, 600
Honduras	1, 500	-----	9, 500	11, 500
India	171, 800	424, 500	169, 500	191, 700
South Africa	1, 194, 600	1, 448, 600	2, 402, 900	1, 891, 500
Straits Settlements	770, 700	1, 260, 400	1, 171, 100	1, 061, 900
West Africa	104, 600	149, 100	228, 800	81, 100
Canary Islands	-----	37, 300	13, 200	98, 600
Ceylon	95, 400	31, 400	50, 900	65, 200
Chile	1, 500, 800	1, 725, 700	2, 084, 500	1, 741, 900
China	4, 300	1, 300	23, 600	7, 500
Colombia	33, 300	116, 100	196, 100	226, 000
Costa Rica	27, 100	116, 200	110, 900	37, 600
Cuba	172, 000	237, 000	32, 600	248, 700
Czechoslovakia	-----	-----	3, 600	7, 700
Denmark	36, 000	21, 600	45, 500	59, 200
Dutch:				
East Indies	98, 000	799, 500	389, 500	512, 100
West Indies	14, 200	55, 500	56, 600	17, 900
Guiana	131, 000	333, 500	338, 700	115, 000
Ecuador	313, 000	590, 700	235, 500	498, 900
Egypt	554, 100	493, 000	459, 500	489, 000
Fiji Islands	-----	-----	-----	-----
Finland	14, 853, 900	16, 530, 000	17, 369, 300	9, 310, 200
France	12, 700	54, 200	29, 800	14, 400
French:				
Africa	-----	1, 000	-----	1, 000
East Indies	-----	-----	-----	-----
Guiana	-----	28, 800	7, 700	28, 100
Oceania	4, 800	-----	-----	-----
West Indies	-----	1, 700	-----	-----
Gambia	84, 500	38, 300	149, 900	77, 400
Germany	-----	13, 400	12, 000	3, 900
Gibraltar	41, 700	82, 200	336, 500	510, 600
Gold Coast	-----	112, 800	251, 100	866, 700
Greece	18, 300	11, 200	6, 100	15, 900
Guatemala	-----	1, 700	-----	-----
Haiti	-----	-----	-----	-----
Hawaii	-----	-----	-----	-----
Holland	27, 500	43, 000	38, 200	20, 500
Hong Kong	-----	55, 200	28, 800	11, 300
Irish Free State	-----	-----	14, 400	-----
Iraq (Mesopotamia)	3, 437, 900	7, 373, 600	4, 877, 500	6, 572, 200
Italy	193, 600	199, 600	221, 800	273, 800
Jamaica	421, 000	1, 400	300	-----
Japan	-----	2, 400	-----	5, 800
Liberia	48, 000	94, 400	69, 200	151, 200
Malta	514, 000	1, 011, 400	824, 200	787, 000
Mexico	2, 400	1, 200	23, 500	16, 600
Morocco	-----	-----	-----	-----
Netherlands	330, 000	745, 900	457, 300	616, 300
Newfoundland	-----	13, 500	1, 000	-----
New Zealand	1, 569, 400	2, 733, 900	2, 586, 300	2, 570, 500
Nicaragua	7, 700	36, 200	61, 400	15, 400
Nigeria	70, 200	49, 900	535, 200	749, 000
Norway	5, 100	12, 000	1, 200	-----
Other British:				
East Indies	-----	-----	-----	9, 600
Oceania	147, 800	297, 000	477, 800	264, 900
West Indies	34, 600	18, 700	86, 300	50, 900
Palestine	43, 200	64, 200	46, 800	78, 400
Panama	42, 900	75, 600	73, 200	70, 700
Peru	268, 400	287, 600	230, 400	191, 700
Philippine Islands	24, 000	4, 800	-----	4, 800
Porto Rico	77, 100	-----	-----	155, 200
Portuguese:				
Africa	103, 200	191, 600	199, 600	263, 200
Asia	-----	-----	2, 400	6, 000
Salvador	2, 700	10, 700	4, 300	8, 800
San Domingo	-----	15, 200	40, 800	19, 600
Siam	2, 100	10, 100	11, 200	5, 300

Exports of canned salmon from Canada, 1916–1927—Continued

Destination	1924	1925	1926	1927
	Pounds	*Pounds*	*Pounds*	*Pounds*
Sierra Leone	40,800	128,600	158,300	32,400
Spain			5,400	1,200
Spanish Africa		5,300	26,600	26,000
St. Pierre and Miquelon	1,700	1,800	1,200	
Sweden	7,200	5,200	10,200	31,400
Switzerland	79,700	80,500	32,400	32,200
Syria		3,800	2,400	59,500
Trinidad and Tobago	59,800	160,400	252,400	226,500
Turkey		28,800	9,800	7,300
United Kingdom	15,263,100	26,576,100	16,588,700	12,775,100
United States	709,300	1,448,000	211,000	2,166,900
United States of Colombia				
Uruguay				4,800
Venezuela	15,600	343,800	625,800	514,400
Virgin Islands of United States	2,400			
Yugoslavia	1,200	5,800	9,400	8,200
Total	54,063,500	77,726,400	67,088,500	60,153,900

SALMON CULTURE [42]

The artificial culture of salmon on the Pacific coast has developed into a large and constantly expanding industry. The United States Bureau of Fisheries operates a number of large and well-equipped hatcheries, while the State governments of California, Oregon, and Washington, the Dominion of Canada and the Province of British Columbia, and certain private companies have built and maintain a large number of hatcheries, some of these being among the largest in the world.

OBTAINING THE SPAWNING FISH

The eggs used for artificial propagation are obtained from salmon taken on their way upstream to the natural spawning grounds. In order to arrest the ascent of the fish a rack is usually built across the stream. Where this is not feasible a trap is sometimes constructed for the purpose of catching the fish. Sometimes the racks have slat traps attached in which some fish are caught.

John Pease Babcock, assistant to the Commissioner of Fisheries of the Province of British Columbia, in 1910 advanced a novel suggestion that freshly fertilized eggs buried immediately under sand and gravel would produce strong healthy fry at less cost than under existing hatching methods, and that fry so produced are stronger and more capable of resisting the attacks of their active enemies. The interesting account of his experiments is reproduced entire: [43]

In writing of the propagation of salmon and trout, some authorities state that considerable loss is occasioned in natural propagation by many of the eggs becoming embedded in sand and gravel; that all the eggs so embedded are lost.

Observation and experiment in the propagation of Pacific salmon and trout for a considerable period lead me to advance the theory that in natural propagation

[42] After the third revision was completed there appeared an excellent work on this subject, entitled "Artificial Propagation of the Salmons of the Pacific Coast," revised and enlarged by Henry O'Malley. Appendix II, Report, U. S. Commissioner of Fisheries, 1919, 32 pp., 9 pls. Washington, 1920. As this report brought the art of fish culture up to date it was decided, in order to reduce the size of this report to eliminate from it the methods of the art and refer the reader to Mr. O'Malley's excellent work. As a result the chapter on Salmon Culture now embraces the historical and statistical aspects.

[43] Some Experiments in the Burial of Salmon Eggs—Suggesting a New Method of Hatching Salmon and Trout. By John Pease Babcock. Transactions, American Fisheries Society, 1910, pp. 393–395. Washington, 1911.

This method has been carried out on a considerable scale by A. Robertson, a Dominion of Canada hatchery superintendent located on the Fraser River, and the results published in "Hatching Salmon Fry in Gravel," Pacific Fisherman, Seattle, Wash., Vol. 17, No. 6, June, 1919, p. 38, illus.

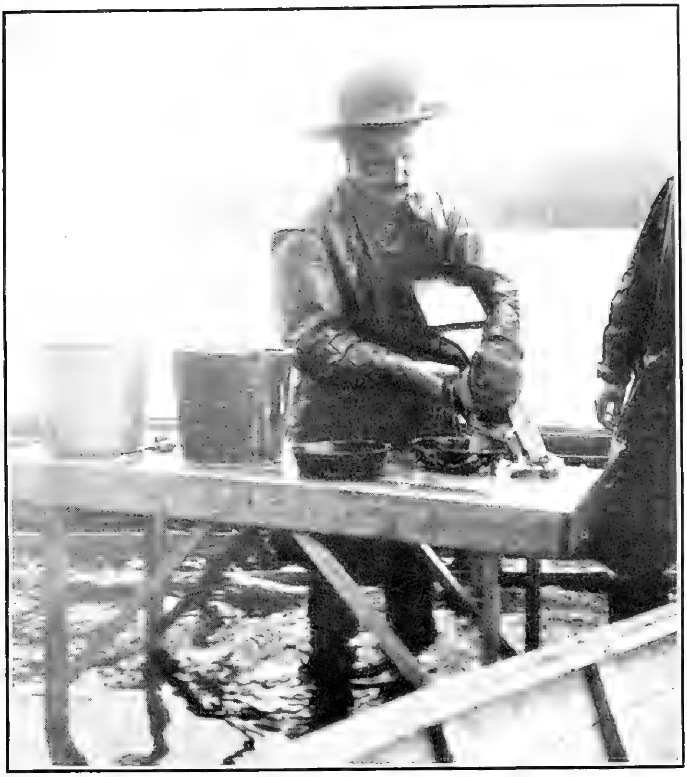

FIG. 40.—STRIPPING SALMON WITH AID OF STRAIT JACKET

FIG. 41.—CHEHALIS HATCHERY, WASHINGTON FISH AND GAME COMMISSION, SHOWING RACKS TO PREVENT SALMON FROM GOING UPSTREAM, AND PEN FOR HOLDING SPAWNING FISH

FIG. 42.—BONNEVILLE SALMON HATCHERY OF THE OREGON FISH AND GAME COMMISSION, SHOWING REARING PONDS

only those eggs which become embedded beneath several inches of sand and gravel produce alevins which live to attain the fry stage; and that those eggs which are not covered by several inches of sand and gravel are either consumed by active aquatic enemies or destroyed by vegetable molds, commonly termed "fungus."

My experiments have demonstrated that the burial of freshly fertilized eggs of the *nerka* and other Pacific salmon does not smother them; that eggs so treated not only live but hatch; and that if they are covered to a sufficient depth the alevins produced survive and possess the instinct and power to work their way gradually to the surface; that if buried beneath 5 or 6 inches of sand and gravel such eggs will hatch, and the young will work their way up through the sand and gravel to the surface, and that by the time they emerge, have absorbed their sacs and are then exempt from the attacks of vegetable molds.

Eggs buried under 1 or 2 inches of sand and gravel produce alevins that work their way up to the surface before the sac is absorbed, and upon reaching the surface are subject to attack by vegetable molds, and a very large percentage are thus destroyed, as well as by the more developed forms of aquatic life.

Eggs buried to a depth of 3 inches produce alevins that work their way to the surface so gradually that by the time they reach the surface their sacs are so nearly absorbed that many, but not all, resist the effects of fungus. Alevins from eggs buried beneath less than 4 inches of sand are liable to reach the surface while the sac is so thinly covered that few, if any, survive the effects of fungous growth.

The spawning beds of Pacific coast streams from California to Alaska (to which my observations have been confined), where the salmon spawn in numbers are, during and after the spawning period, covered with more or less vegetable molds. These molds are particularly common in the beds of streams where great numbers of salmon have spawned and died. Every experienced fish culturist knows that most waters carry great numbers of spores of fungi, and how difficult it is to prevent eggs and alevins from being attacked and injured by their growth. I believe that in natural propagation fungous growths destroy more salmon eggs and alevins than all other causes combined. The vegetable molds of Pacific streams are not active beneath the surface of the beds of streams. Salmon eggs cast therein, if even thinly covered with sand, are not injured by them. These molds do not affect the fry that have nearly or entirely absorbed their sacs, but they are deadly if permitted to attach themselves to either the eggs or the alevins.

My experiments along this line lead me to express the opinion that by the burial of freshly fertilized salmon eggs under 6 or 7 inches of sand and gravel strong healthy fry can be produced at less cost than under existing hatching methods, and that fry so produced are stronger and more capable of resisting the attacks of their active enemies.

I trust that this short statement of my experiments in the burial of salmon eggs may be deemed of sufficient economic importance to stimulate fish culturists generally in experimenting along similar lines. Those who do will perhaps experience some difficulty at first in the covering of a large number of eggs. Experimenters will find that after preparing suitable beds of sand and small gravel the eggs can be evenly laid and held until covered, if the surface of the bed is first thickly indented with cells a little deeper than the eggs. This can be readily accomplished by stamping the bed with a board covered with projections or pegs of suitable size.

My experiments suggest that in the near future most of the buildings and hatching apparatus now used in the propagation of salmon and trout will be dispensed with; that after the eggs have been expressed and fertilized, instead of being placed in wire baskets in hatcheries, they will be buried beneath the sand and gravel of the beds of natural or prepared streams, and that with the exception of watchmen to protect them, little or no other labor will be required.

The subsequent development of this practice has been largely confined to British Columbia. Some 30,000,000 eyed eggs were planted in inaccessible waters by the Canadian hatcheries in 1927. In the United States such plants have been made in only a limited number of instances.

REARING SALMON FRY

For many years it was the custom to plant the fry as soon as they had absorbed the yolk sac, a period of about 30 days. A few thousands were sometimes raised to the fingerling, yearling, or adult stage, more as a curiosity than anything else. No particular difficulty was experienced in raising these fish, but the expense entailed in feeding them for a prolonged period, and the impossibility of doing so unless large ponds were constructed at great expense for the purpose of holding them during the feeding period, prevented the general adoption of the rearing system.

For some years certain fish culturists and others had contended that the planting of fry just after they had absorbed the umbilical sac was an economic mistake, claiming that at this age they were weak and comparatively sluggish in their movements, and would fall easy prey to their numerous fish, bird, and other enemies. The late Robert D. Hume, who built and operated a hatchery on the lower Rogue River, also one on the upper Rogue River, which the United States Bureau of Fisheries operated for some years, was one of the first to take up the rearing of salmon fry on any scale.

In time these objections bore weight, and a few years ago the construction of ponds in which fry could be held and fed until they had reached a size which would insure them at least an even chance for their lives was undertaken all along the coast, with the result that to-day there is a pond capacity for about one-half of the total capacity of the various hatcheries.

Most of the nursery ponds have been constructed near the hatcheries and usually comprise oblong trenches dug in the earth and walled with cement and stone.

In Oregon the State authorities found that the best results in pond rearing were obtained by using creek or natural ponds, which were made by placing dams across the small streams in the vicinity of the hatcheries. When first taken from the hatching troughs the fry are placed in the artificial ponds until the danger from spring freshets in the small streams is over. They are then transferred to the natural ponds, where the continual flow of fresh water, and the logs, rocks, etc., which provide shade and shelter, afford more natural conditions, and in which the natural food of the fry supplements the artificial food provided by man.

A big advantage in connection with the use of natural ponds is the comparatively small expense involved in providing for them as compared with the large expense involved in the construction of cement ponds.

The young fry show when they are ready to feed by darting to one side or the other when small particles of food are dropped in the water and float past them. For the first few weeks they should be fed regularly and as often as six times a day, and the earlier in the day the feeding begins and the later it continues at night the better. Two hours after feeding they will be found to be ravenously hungry, and as they grow much faster for frequent feeding great care should be taken to see that they are well fed. If not fed sufficiently, they will bite at one another and cause more or less mortality among themselves.

FIG. 43.—UNITED STATES SALMON HATCHERY, YES BAY, ALASKA

FIG. 44.—UNITED STATES SALMON HATCHERY, AFOGNAK, ALASKA

FIG. 45.—ALASKA PACKERS ASSOCIATION FORTMANN HATCHERY, NAHA STREAM, ALASKA

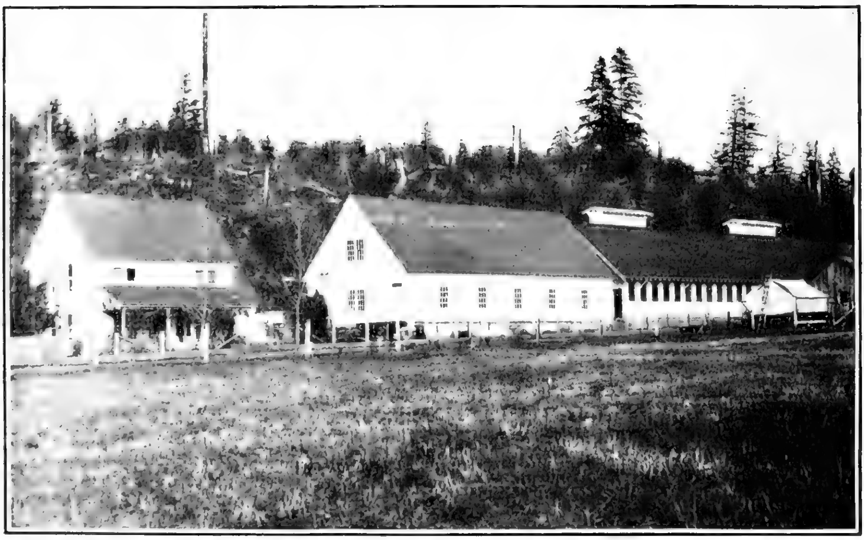

FIG. 46.—CHEHALIS HATCHERY, WASHINGTON FISH AND GAME COMMISSION, SATSOP, WASH.

SALMON HATCHERIES ON THE PACIFIC COAST

Below is shown a list of the salmon and steelhead-trout hatcheries operated on the Pacific coast during the year 1929:

UNITED STATES BUREAU OF FISHERIES

Alaska:
- Afognak.
- Yes Bay.

California:
- Baird.
- Battle Creek.
- Mill Creek.

Oregon:
- Clackamas.
- Applegate.
- Snake River.
- Rogue River.
- Upper Clackamas.

Washington:
- Baker Lake.
- Birdsview.
- Brinnon.
- Duckabush.
- Illabott Creek.
- Quilcene.
- Big White Salmon.
- Little White Salmon.

STATE OF CALIFORNIA

Mount Shasta and Klamath River.
Fort Seward.
Fall Creek.

STATE OF OREGON

Herman Creek.
Wallowa River.
McKenzie River.
Bonneville.
Santiam River.
Klaskanine.
Willamette River.
Tillamook.
Siuslaw.
Umpqua.
South Coos.
Coquille.
Alsea.
Rogue River.
Nehalem.
Trask.
Scottsburg.

STATE OF WAHINGTON

Chambers Creek.
Chehalis.
Chehalis No. 2.
Chinook.
Cowlitz River.
Dungeness.
Green River.
Kittitas.
Nasel River.
Nooksack.
Pilchuck.
Puyallup River.
Samish.
Skykomish.
Stillaguamish.
Kalama.
Pateros-Methow.
Wenatchee.
Wind River.
Humptulips.
Willapa.

DOMINION OF CANADA

Cultus Lake.
Pemberton.
Stuart Lake.
Babine Lake.
Rivers Inlet.
Anderson Lake.
Kennedy Lake.
Cowichan Lake.
Pitt Lake.

PROVINCE OF BRITISH COLUMBIA

Seton Lake.

BRITISH COLUMBIA PACKERS ASSOCIATION

Nimpkish Lake.

ALASKA (PRIVATE HATCHERY)

Northwestern Fisheries Co.:
- Quadra.

GENERAL STATISTICS

Distribution of fry, etc.—In the next table is shown by years and species the distribution in Pacific coast waters of fry, fingerlings, yearlings, and adults from 1873, when the first hatchery began operation, to 1928, inclusive. The figures on fingerlings, yearlings, and adults are not as complete as could be wished, this being due to certain of the State fish commissions not separating them from the fry in the published results.

The table shows the enormous total of 12,330,512,122 fry and 1,045,726,909 fingerlings, yearlings, and adults as having been deposited in local waters since the inception of the work on this coast. Of these nearly one-half were sockeye, or red salmon, followed by chinook, or spring, coho, or silver, chum, steelhead trout, and humpback salmon in the order named.

This table does not show the large number of eggs, fry, etc., shipped from the coast hatcheries to other sections of the country and to various foreign countries. These appear in the tables shown under the various States, Provinces, and Territories.

Distribution of salmon in the Pacific coastal streams of North America, in specified years

Year	Chinook, king, or spring		Coho or silver		Chum		Humpback or pink	
	Fry	Fingerlings, yearlings, and adults	Fry	Fingerlings, yearlings, and adults	Fry	Fingerlings, yearlings, and adults	Fry	Fingerlings, yearlings, and adults
1873	520, 000							
1874	850, 000							
1875	2, 250, 000							
1876	2, 000, 000							
1877	2, 550, 000							
1878	2, 582, 620							
1879	5, 376, 500							
1880	4, 059, 290							
1881	4, 974, 790							
1882	3, 991, 750							
1884	600, 000							
1886	150, 000							
1887	200, 000							
1888	2, 590, 000							
1889	8, 168, 000							
1890	5, 250, 475							
1891	9, 269, 000							
1892	4, 299, 000	25, 000						
1893	10, 825, 950							
1894	8, 427, 900		280, 000					
1895	6, 458, 000		910, 000	560, 000				
1896	25, 581, 033	807, 150						
1897	31, 146, 095		298, 137					
1898	73, 684, 076							
1899	56, 773, 351		189, 000					
1900	33, 974, 064		13, 925, 104		10, 301, 760			
1901	36, 563, 138	1, 668	20, 047, 935		16, 478, 280			
1902	73, 852, 120		41, 436, 123		9, 937, 390			
1903	75, 558, 389		34, 460, 291		10, 012, 390			
1904	161, 530, 963		23, 894, 026				521, 797	
1905	143, 714, 117		30, 743, 492					
1906	167, 745, 494	122, 980	47, 356, 449	300	3, 268, 800		969, 990	
1907	124, 578, 390		44, 426, 380		6, 120, 000		4, 224, 255	
1908	135, 447, 179	2, 165, 797	54, 108, 557		4, 342, 350		31, 920, 662	
1909	88, 188, 707	16, 949	50, 648, 674		7, 805, 000		10, 000	
1910	97, 361, 532	225	45, 863, 952		8, 607, 500		2, 251, 340	
1911	80, 570, 265	11, 700	52, 869, 759		13, 435, 750		460, 150	
1912	101, 810, 515	1, 405, 860	66, 087, 446	116, 300	4, 684, 950		34, 205, 460	
1913	112, 008, 886		79, 313, 839		35, 792, 440		1, 888	
1914	133, 271, 477	2, 571, 711	67, 682, 576		16, 623, 984		39, 685, 814	
1915	149, 666, 221	9, 875, 745	92, 926, 831		63, 088, 372		7, 867, 484	
1916	151, 649, 595	26, 070, 128	56, 647, 147	5, 543, 712	63, 390, 798	1, 000, 000	15, 842, 627	2, 915, 000
1917	96, 975, 725	27, 060, 581	17, 828, 235	4, 663, 560	26, 133, 925	7, 014, 580	4, 953, 000	7, 449, 030
1918	133, 102, 069	22, 384, 610	55, 697, 111	10, 148, 815	82, 020, 140		22, 159, 186	4, 736, 000
1919	67, 908, 011	58, 007, 670	32, 207, 426	3, 286, 580	26, 772, 025	4, 524, 560	5, 426, 000	369, 958
1920	124, 741, 938	66, 408, 670	106, 879, 090	1, 842, 550	37, 450, 425	5, 916, 300	1, 380, 200	
1921	67, 598, 711	63, 434, 765	73, 616, 268	6, 571, 700	128, 550, 237	24, 504, 300	7, 077, 100	
1922	97, 624, 865	108, 819, 170	65, 166, 590	11, 174, 940	29, 474, 210	14, 027, 610	4, 846, 300	909, 400
1923	106, 698, 933	54, 044, 545	67, 281, 795	6, 249, 445	10, 786, 590	15, 160, 400	19, 309, 567	1, 672, 435
1924	142, 814, 464	59, 667, 905	105, 453, 212	11, 552, 000	33, 866, 101	1, 523, 600	8, 948, 944	
1925	147, 420, 665	25, 155, 100	104, 209, 247	4, 383, 639	27, 471, 224	2, 501, 000	41, 286, 175	2, 946, 000
1926	156, 062, 256	69, 061, 600	108, 741, 808	5, 156, 400	36, 362, 587		19, 368, 915	
1927	182, 537, 463	47, 263, 800	81, 786, 234	1, 638, 500	28, 675, 805		8, 858, 000	
1928	155, 560, 442	64, 381, 420	101, 391, 211	2, 073, 500	40, 560, 082		9, 221, 650	
Total	3, 619, 114, 424	708, 764, 749	1, 744, 373, 945	74, 961, 941	782, 013, 115	76, 172, 350	290, 796, 504	20, 997, 823

Distribution of salmon in the Pacific coastal streams of North America, in specified years—Continued

Year	Sockeye, red, or blueback		Steelhead trout		Total	
	Fry	Fingerlings, yearlings, and adults	Fry	Fingerlings, yearlings, and adults	Fry	Fingerlings, yearlings, and adults
1873					520, 000	
1874					850, 000	
1875					2, 250, 000	
1876					2, 000, 000	
1877					2, 550, 000	
1878					2, 582, 620	
1879					5, 376, 500	
1880					4, 059, 290	
1881					4, 974, 790	
1882					3, 991, 750	
1884					600, 000	
1885	1, 800, 000				1, 800, 000	
1886	2, 625, 000				2, 775, 000	
1887	4, 414, 000				4, 614, 000	
1888	5, 807, 000				8, 397, 000	
1889	4, 419, 000				12, 587, 000	
1890	6, 640, 000				11, 890, 475	
1891	3, 603, 800				12, 872, 800	
1892	6, 000, 000				10, 299, 000	25, 000
1893	6, 274, 000				17, 099, 950	
1894	8, 504, 000		353, 500		17, 565, 400	
1895	11, 681, 000				19, 049, 000	560, 000
1896	15, 868, 000		107, 808		41, 556, 841	807, 150
1897	18, 374, 440		262, 000		50, 080, 672	
1898	20, 916, 000		650, 000		95, 250, 076	
1899	15, 761, 000		8, 625		72, 731, 976	
1900	29, 590, 000		2, 061, 560		89, 852, 488	
1901	19, 901, 253		1, 709, 326		94, 699, 932	1, 668
1902	72, 679, 000		3, 243, 948		201, 148, 581	
1903	89, 398, 789		4, 509, 641	37, 033	213, 939, 500	37, 033
1904	70, 710, 200		4, 207, 920		260, 864, 906	
1905	119, 963, 200		3, 805, 675		298, 226, 484	
1906	232, 037, 442		6, 725, 965	24, 383	458, 104, 140	147, 663
1907	228, 018, 450		5, 629, 493		412, 996, 968	
1908	230, 528, 455		5, 837, 671		462, 184, 874	2, 165, 797
1909	239, 251, 146		8, 193, 778		394, 097, 305	16, 949
1910	396, 215, 795		11, 368, 446		561, 668, 565	225
1911	257, 463, 497		14, 995, 717		419, 795, 138	11, 700
1912	324, 325, 768		12, 710, 382	177, 790	543, 824, 521	1, 699, 950
1913	242, 146, 069		16, 654, 906		485, 918, 028	
1914	261, 365, 781		11, 719, 558		530, 349, 190	2, 571, 711
1915	198, 910, 010	8, 369, 830	22, 942, 900		535, 401, 818	18, 245, 575
1916	256, 582, 879	15, 292, 732	18, 952, 136	3, 480, 092	563, 065, 182	54, 301, 664
1917	215, 853, 504	12, 305, 953	15, 241, 720	1, 887, 950	376, 986, 109	60, 381, 654
1918	155, 043, 461	12, 705, 285	18, 480, 440	3, 520, 420	466, 502, 407	53, 495, 130
1919	62, 397, 320	14, 299, 960	17, 755, 206	135, 500	212, 465, 988	80, 624, 228
1920	245, 403, 605	676, 615	31, 576, 780	2, 693, 250	547, 432, 038	77, 537, 385
1921	151, 125, 130	4, 093, 970	16, 383, 856	3, 785, 550	444, 351, 302	102, 390, 285
1922	186, 916, 052	8, 195, 000	19, 677, 824	2, 028, 220	403, 705, 841	145, 154, 340
1923	174, 210, 216	3, 885, 126	24, 925, 709	4, 683, 105	403, 212, 810	85, 695, 056
1924	166, 605, 240	9, 855, 310	33, 464, 943	5, 547, 240	491, 152, 904	88, 146, 055
1925	185, 524, 414	7, 971, 887	21, 153, 141	1, 657, 275	527, 064, 866	44, 614, 901
1926	218, 248, 487	12, 942, 680	23, 504, 593	4, 659, 840	562, 288, 646	91, 820, 520
1927	206, 414, 631	8, 421, 670	9, 416, 882	839, 700	517, 689, 015	58, 163, 670
1928	111, 203, 403	8, 372, 980	25, 261, 648	2, 283, 700	443, 198, 436	77, 111, 600
Total	5, 480, 720, 437	127, 388, 998	413, 493, 697	37, 441, 0481	2,330,512,122	1, 045, 726, 909

Output of United States Bureau of Fisheries hatcheries.—The next table shows by years and species the combined output of the various hatcheries of the United States Bureau of Fisheries on this coast. The greater part of the egg output was to various State hatcheries on the Pacific coast, more particularly those belonging to the State of California. The total figures show that since the bureau began operations on this coast it has distributed 1,643,354,071 eggs, 2,700,214,782 fry, and 735,061,098 fingerlings, yearlings, and adults.

Output of Pacific coast salmon hatcheries owned by the United States Bureau of Fisheries, 1872 to 1928

Year	Chinook, king, or spring			Coho or silver		
	Eggs	Fry	Fingerlings, yearlings, and adults	Eggs	Fry	Fingerlings, yearlings, and adults
1872	30,000					
1873	1,400,000					
1874	4,155,000	850,000				
1875	6,250,000	1,750,000				
1876	5,065,000	1,500,000				
1877	4,983,000	2,000,000				
1878	7,810,000	2,500,000				
1879	4,250,000	2,300,000				
1880	3,800,000	2,000,000				
1881	4,300,000	3,100,000				
1882		3,991,750				
1883		776,125				
1889 [1]	3,450,000	6,000,000				
1890	2,554,000	2,860,475				
1891	3,688,000	5,678,525				
1892	2,902,000	1,647,900				
1893	3,530,000	5,290,100				
1894	7,500,000	651,500			280,000	
1895	3,699,000	500,000			690,000	560,000
1896	2,798,500	3,547,850	557,150			
1897	18,232,590	9,828,095			298,137	
1898	30,605,000	39,950,698				
1899	32,618,000	9,366,366				
1900	7,411,000	14,287,264			146,824	
1901	11,615,036	7,987,107	1,668		302,041	
1902	19,446,410	29,340,308			424,530	
1903	16,160,177	23,845,956	250	680,800	81,812	
1904	75,217,354	35,006,988			3,984,645	
1905	96,055,765	21,620,292		107,000	9,321,513	
1906	115,648,145	20,797,543	123,118	239,180	6,445,574	300
1907	78,587,705	17,567,092		760,000	3,636,952	
1908	68,520,550	21,998,185	2,165,797	296,000	13,420,714	57,932
1909	38,859,265	20,177,286	16,949	272,000	9,470,925	
1910	38,306,709	15,682,061	225	275,000	10,888,025	
1911	37,314,514	16,659,684	211,700	2,391,900	6,210,296	
1912	36,837,550	31,040,893	1,405,860	52,000	12,955,824	
1913	58,296,873	33,419,423		202,000	13,952,963	
1914	31,032,645	48,895,607	5,582,796	95,840	24,619,456	27,258
1915	25,751,005	53,612,056	9,604,985	111,200	24,018,355	267,662
1916	20,622,340	57,870,714	22,982,655	198,500	8,124,334	1,469,507
1917	7,191,200	16,404,404	27,858,026		4,403,700	4,662,960
1918	18,074,900	6,028,918	63,176,244		980,300	10,504,115
1919	12,782,500	389,002	34,088,150		7,544,020	1,291,730
1920	11,267,000	1,250,000	38,366,070		68,411,050	1,820,500
1921	6,780,000		40,947,265		600,000	6,571,700
1922	1,420,000	1,311,500	57,987,870		600,000	11,074,940
1923	4,200,000	716,000	30,174,345	100,000	8,371,025	5,910,655
1924	12,785,000	2,243,000	27,389,605		11,419,990	11,430,150
1925	7,494,880	2,528,800	10,106,900	862,000	10,177,650	3,797,639
1926	10,656,640	545,000	24,659,600	211,000	4,555,800	5,156,400
1927	9,112,000	266,000	26,912,800	148,000	5,142,400	1,638,500
1928	19,033,000	342,500	35,369,920	1,025,000	10,852,200	2,073,500
Total	1,050,109,253	610,923,070	459,689,948	8,027,420	282,331,055	68,315,448

[1] Operations suspended from 1884 to 1888, both inclusive.

Output of Pacific coast salmon hatcheries owned by the United States Bureau of Fisheries, 1872 to 1928—Continued

Year	Chum		Humpback, or pink			Sockeye, red, or blueback		
	Fry	Fingerlings, yearlings, and adults	Eggs	Fry	Fingerlings, yearlings, and adults	Eggs	Fry	Fingerlings, yearlings, and adults
1900							10, 683, 000	
1901							3, 834, 453	
1902							3, 371, 000	
1903							3, 731, 789	
1904				176, 597			3, 855, 000	
1905							7, 819, 281	10, 000
1906			2, 000	969, 990		880, 000	9, 923, 680	9, 500
1907							58, 835, 055	
1908			502, 000	6, 764, 762		75, 000	69, 883, 305	
1909				10, 000		100, 000	93, 408, 496	
1910				1, 731, 740			146, 081, 595	
1911	911, 650		100, 000	460, 150			100, 490, 900	
1912	2, 495, 000		3, 271, 740	2, 566, 325		2, 000, 000	91, 422, 273	
1913	19, 479, 000			1, 880		2, 000, 000	78, 724, 900	
1914	8, 672, 735		13, 260, 000	37, 648, 422	4, 355	6, 020, 000	53, 071, 574	120, 000
1915	35, 504, 707		14, 500, 000	7, 153, 500	119, 480	155, 000	46, 282, 691	8, 416, 405
1916	21, 500, 944	1, 000, 000	7, 000, 000	6, 106, 400	2, 915, 000	3, 100, 000	90, 988, 566	2, 666, 308
1917	14, 403, 300	7, 014, 580		165, 000	7, 499, 030	2, 000, 000	84, 152, 825	2, 145, 953
1918	9, 892, 145			2, 132, 831	3, 736, 000	18, 000, 000	67, 591, 200	12, 705, 285
1919	4, 544, 000	4, 524, 560	10, 062, 000	5, 426, 500	369, 958	101, 981, 000	48, 393, 000	25, 959, 960
1920	7, 318, 100	5, 667, 150		64, 700		88, 930, 000	70, 911, 000	
1921	7, 000, 000	19, 436, 400						
1922	1, 540, 000	14, 027, 610		210, 000	909, 400		4, 200, 000	7, 701, 635
1923	8, 324, 830	14, 902, 900	1, 149, 200	633, 600	1, 672, 435	86, 790, 000	84, 632, 045	1, 998, 400
1924	23, 512, 320	758, 000		918, 000		28, 870, 000	30, 337, 640	4, 528, 000
1925	16, 051, 650			10, 892, 500		33, 230, 000	49, 152, 000	2, 845, 000
1926	18, 163, 400			844, 600		50, 830, 000	47, 263, 000	6, 979, 180
1927	17, 966, 000		4, 212, 000	3, 544, 000		52, 135, 000	45, 430, 000	2, 668, 170
1928	23, 669, 000			2, 387, 000		28, 875, 408	29, 979, 000	2, 613, 600
Total	240, 948, 781	67, 331, 200	54, 058, 940	90, 808, 497	17, 225, 658	505, 971, 408	1, 434, 449, 268	81, 367, 396

Year	Steelhead trout			Total		
	Eggs	Fry	Fingerlings, yearlings, and adults	Eggs	Fry	Fingerlings, yearlings, and adults
1872				30, 000		
1873				1, 400, 000		
1874				4, 155, 000	860, 000	
1875				6, 250, 000	1, 750, 000	
1876				5, 035, 000	1, 500, 000	
1877				4, 983, 000	2, 000, 000	
1878				7, 810, 000	2, 500, 000	
1879				4, 250, 000	2, 300, 000	
1880				3, 800, 000	2, 000, 000	
1881				4, 300, 000	3, 109, 000	
1882					3, 991, 750	
1883					776, 125	
1889 [1]				3, 450, 000	6, 000, 000	
1890				2, 554, 000	2, 860, 475	
1891				3, 688, 000	5, 678, 525	
1892				2, 902, 000	1, 647, 900	
1893				3, 530, 000	5, 290, 100	
1894	75, 000	308, 500		7, 575, 000	1, 249, 000	
1895		852, 500	332, 000	3, 699, 000	2, 042, 500	892, 000
1896	175, 000	107, 808		2, 973, 500	3, 655, 658	557, 150
1897	50, 000	257, 000		18, 282, 590	10, 383, 232	
1898	60, 000	650, 000		30, 665, 000	40, 600, 698	
1899	159, 000	12, 125		32, 777, 000	9, 378, 491	
1900	415, 000	125, 000		7, 826, 000	25, 242, 088	
1901	246, 000	65, 850	25, 000	11, 861, 036	12, 189, 451	26, 068
1902	481, 000	130, 250		19, 927, 410	33, 266, 088	
1903	480, 000	702, 700	285, 848	17, 320, 977	28, 362, 257	286, 098
1904	225, 000	93, 205	11, 090	75, 442, 354	43, 116, 435	11, 090
1905	464, 400	537, 205		96, 627, 165	39, 298, 291	10, 000
1906	358, 000	1, 834, 485	40, 383	117, 127, 325	39, 971, 272	173, 301
1907	250, 000	1, 190, 305		79, 597, 705	81, 229, 404	
1908	487, 725	1, 089, 596		69, 881, 275	116, 156, 562	2, 223, 729
1909	482, 725	1, 670, 371		39, 714, 990	124, 737, 078	16, 949
1910	300, 000	3, 511, 226		38, 881, 709	177, 894, 650	225
1911	660, 000	3, 826, 439		40, 466, 414	128, 559, 119	211, 700
1912	905, 000	4, 289, 415	294, 090	43, 066, 290	144, 769, 730	1, 699, 950

[1] Operations suspended from 1884 to 1888, both inclusive.

Output of Pacific coast salmon hatcheries owned by the United States Bureau of Fisheries, 1872 to 1928—Continued

Year	Steelhead trout			Total		
	Eggs	Fry	Fingerlings, yearlings, and adults	Eggs	Fry	Fingerlings, yearlings, and adults
1913	1, 330, 000	4, 272, 225		61, 828, 873	149, 850, 391	
1914	729, 000	4, 022, 438		51, 137, 485	176, 930, 232	5, 734, 409
1915	877, 000	5, 262, 973	1, 048, 317	41, 394, 205	171, 834, 282	19, 456, 849
1916	1, 490, 000	841, 600	2, 676, 805	32, 410, 840	185, 432, 558	34, 710, 275
1917	3, 237, 600	2, 013, 510	1, 891, 450	12, 428, 800	121, 542, 739	51, 071, 999
1918	1, 070, 000	103, 000	6, 854, 785	37, 144, 900	86, 728, 394	96, 976, 429
1919	775, 000		1, 148, 000	125, 600, 500	66, 296, 522	67, 382, 358
1920	941, 600	138, 200	2, 532, 650	101, 147, 600	148, 093, 150	48, 386, 370
1921	493, 000	15, 000	3, 785, 550	7, 273, 000	7, 615, 000	70, 740, 915
1922	500, 000		2, 028, 220	1, 920, 000	7, 861, 500	93, 729, 675
1923	1, 744, 000	260, 000	3, 960, 105	43, 835, 000	102, 937, 500	48, 876, 215
1924	2, 180, 000	368, 685	4, 770, 460	42, 193, 880	68, 799, 635	17, 932, 814
1925	607, 000	50, 000	1, 183, 275	62, 825, 640	88, 852, 600	41, 077, 200
1926	1, 128, 000	970, 000	4, 282, 020	66, 057, 000	72, 341, 800	32, 049, 170
1927	450, 000		829, 700	50, 293, 408	72, 348, 400	42, 208, 720
1928	1, 360, 000	1, 182, 500	2, 151, 700	93, 983, 200	68, 412, 200	58, 618, 840
Total	25, 187, 050	40, 754, 111	41, 131, 448	1, 643, 354, 071	2, 700, 214, 782	735, 061, 098

ACCLIMATIZING PACIFIC SALMON IN OTHER WATERS

For many years efforts have been made by the United States Bureau of Fisheries and various State fish commissions to introduce Pacific coast salmon in eastern waters. In the early history of fish culture chinook fry were planted in almost every imaginable stream along the Atlantic seaboard, in various streams in the Mississippi Valley, and also in tributaries of the Great Lakes. In most cases, owing to the unsuitability of the water, the experiment was doomed to failure from the start. In the case of a few streams where results might have been obtained, the plantings were at long intervals and the fish were too small to protect themselves, while no effort was made by the State authorities to protect them.

The most successful results with plants of chinook salmon have been obtained in Lake Sunapee, N. H., where it is now a not uncommon thing for anglers to catch chinook with rod and reel.

In 1912 about 10,000 chinook fingerlings from Columbia River eggs furnished by the United States Bureau of Fisheries were planted by the Massachusetts Fish Commission in Lake Quinsigamond, and during July, 1914, about 20 months after they were hatched, over 600 salmon, according to a member of the commission, were caught, ranging from 1½ to 5 pounds each.

Other plants have been made since in Lake Quinsigamond and other lakes and ponds, with fairly satisfactory results.

The most successful effort in this line was initiated by the United States Bureau of Fisheries in the fall of 1913, when it transferred from its hatcheries on the Pacific coast to those in Maine 13,240,000 humpback-salmon eggs. These were followed by a second shipment of 7,022,000 eggs in the fall of 1914, a third shipment of about 7,000,000 eggs in the fall of 1915, and a few smaller shipments subsequently. These eggs were hatched out and the fry planted in various selected New England streams where the conditions seemed favorable.

Early in August, 1915, a female humpback salmon 22½ inches long and weighing 4 pounds 3 ounces was taken at the Bangor waterworks in the Penobscot River. Shortly after, a male fish of about the same size was taken in this river at Orland Dam. A little later, agents of the bureau captured 20 alive near Bangor, and about 3,000 eggs were obtained and fertilized.

In Dennys River, in Maine, during the period between August 15 and September 24, local fishermen caught a number. Since then they have been running regularly each season into certain of these streams.

The chinook salmon has also been acclimatized in the waters of New Zealand. They were first introduced in 1900, and eggs were imported for six years in succession. A considerable annual run now enters those rivers in which the salmon were planted.

In 1908 the United States Bureau of Fisheries initiated an effort to establish a run of sockeye salmon in Grandy Creek, a stream in the immediate vicinity of the Birdsview (Wash.) hatchery of the bureau, and one which had not been visited by this species. The first fish, numbering 64,000, were planted in the creek in 1908. Four years afterwards, in September, 1912, the first sockeye salmon entered the hatchery trap in Grandy Creek, and from them 222,000 eggs were secured. In 1916 the water in the creek was too low to permit the ascent of salmon until September 26, when its level was slightly raised by local rains, and a few fish immediately entered it and were taken in the hatchery trap. The eggs secured from the small number available amounted to 24,500. The fish have since continued to run in this stream.

In 1916 L. H. Darwin, commissioner of fish and game for the State of Washington, began an experiment looking to the stocking, with sockeye salmon, of the Samish River, a stream debouching in Puget Sound, and in which this species had not hitherto been found. The parent fish were obtained from traps and transported alive in crates to the Samish State hatchery, where they were held until ripe and then stripped and fertilized. After hatching, the fry were planted in the stream. A few returned in 1920.

Since then the practice has been followed to some extent in other streams, and the possibility of establishing a run of nonindigenous species of salmon in suitable streams by hatchery plants has been well demonstrated.

CALIFORNIA

HISTORY

The first fish-cultural station on the Pacific coast was located on McCloud River, a stream of the Sierra Nevada Mountains emptying into Pit River, a tributary to the Sacramento, 323 miles nearly due north of San Francisco. The site on the west bank of the river, about 3 miles above the mouth, was chosen after investigation of a number of places on the Sacramento, by Livingston Stone, one of America's pioneer fish culturists, and the station was named Baird, in honor of the then Commissioner of Fisheries, Prof. Spencer F. Baird. Although the season had nearly passed when the station was sufficiently advanced to handle eggs, 50,000 eggs were secured, and while 20,000 were lost, owing to the excessive heat, the remaining 30,000 were shipped east, all of which were eventually lost but 7,000 fry, which were planted in the Susquehanna River, in Pennsylvania.

The main object of the hatchery the first few years was to secure eggs to ship to the East for the purpose of introducing Pacific salmon in the waters of that section. The commission early made an agreement with the State of California, however, under which the latter at first paid part of the expense, and the commission hatched and planted a portion of the take in the McCloud River. Later, part of the eggs were turned over to the States, which hatched and planted the salmon in local waters.

In 1881 the station buildings were washed away in a freshet, but were immediately rebuilt. From 1884 to 1887, both inclusive, all operations were suspended.

In 1889 a hatchery was established at Fort Gaston, on the Army reservation in the Hoopa Indian Reservation in Humboldt County, but it was not put into operation until 1890. As the reservation was abolished on July 1, 1892, the commission took complete charge of the plant and in 1893 established a tributary station on Redwood Creek. The same year Korbel station was established about one-half mile above Korbel, on Mad River, in Humboldt County. Owing to the lack of money this station was closed in the fiscal year 1896, but was reopened during the fiscal year 1897.

That same year the commission erected, on ground owned by the State, a hatchery at Battle Creek, in Tehama County, and also took charge of and operated the hatchery erected at this place by the State fish commission the previous year. Under the terms of an agreement the commission was to deliver to the States as many eyed spawn as the latter could hatch at Sisson, its own station.

Owing to their inaccessibility, the Fort Gaston hatchery and its substations were abandoned in 1898. The same year an experimental station was established at Olema, Bear Valley, in Marin County, whence eggs were transferred from Baird station, hatched out here, and planted in Olema Creek in order to see if they could not be domesticated here, where they had not been found previously.

During the fiscal year 1902 a substation was established on Mill Creek, a stream which has its source in the foothills of the Sierra Mountains, in the northeastern part of Tehama County, and empties into the Sacramento River from the east about a mile above the town of Tehama. The eggs are retained here until eyed and then shipped to other hatcheries.

As stated above, the State aided the work of the United States Fish Commission in a financial way and also by hatching and distributing the eggs turned over to its care. In 1885 the State legislature passed a bill authorizing the establishment of a hatchery of its own, and the same year such a station was built upon Hat Creek about 2½ miles above its junction with Pitt River, a tributary of the Sacramento River. As the work of the first few seasons developed that the location was unsuitable, the hatchery was removed in 1888 to Sisson, in Siskiyou County. It is now known as the Mount Shasta hatchery. The work of this hatchery was to handle the eggs turned over to it by the United States Fish Commission. It was almost doubled in size in 1917.

In 1895 another hatchery was built by the State near the mouth of Battle Creek, a tributary of the Sacramento River. In 1896 and 1897 this hatchery was operated jointly by the State and the United States Fish Commission while awaiting the appropriation of money by the commission to purchase it from the State.

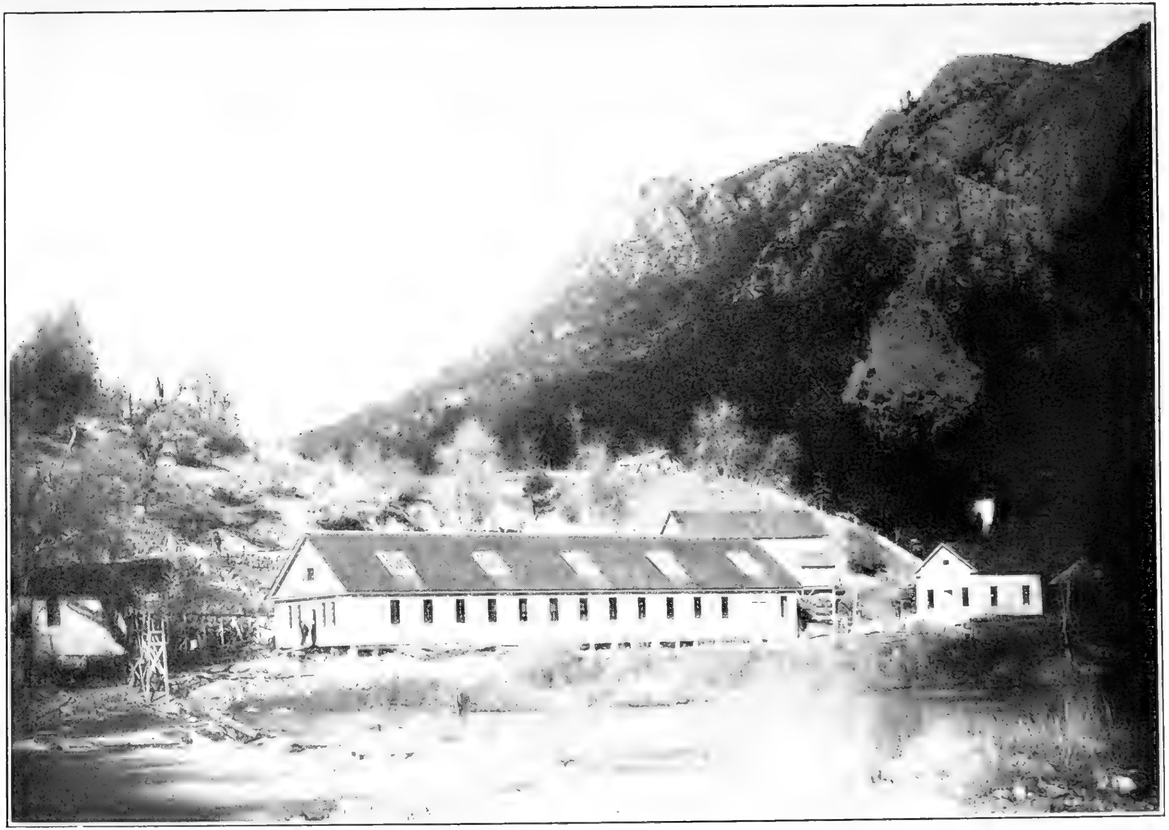

FIG. 47.—UNITED STATES BUREAU OF FISHERIES HATCHERY AT BAIRD, CALIF.; THE FIRST FISH-CULTURAL STATION ON THE PACIFIC COAST

FIG. 48.—MOUNT SHASTA HATCHERY OF THE CALIFORNIA FISH AND GAME COMMISSION, AT SISSON, CALIF.

In the fall of 1897 a hatchery was established by the State at Grizzly Bluff, on Price Creek, a tributary of Eel River, in Humboldt County, and in 1902 this hatchery made the first plant in the State of steelhead trout fry. In 1916 it was moved to a point on Eel River near Fort Seward.

Santa Cruz County has had a hatchery at Brookdale for a number of years. In 1911 it was leased to the State and operated by the latter during the seasons of 1911 and 1912. In 1913 the State gave up the lease and entered into a contract to purchase the eggs produced from this hatchery. The price agreed upon was that the State commission was to pay $1.50 per thousand for the eyed steelhead eggs, up to the number of 2,000,000, and $1 per thousand for all eggs up to 3,000,000, provided that the eggs were collected and eyed by a skilled fish culturist and would pass inspection before they were accepted. In 1916 the State leased the plant for a term of years.

A hatchery was established by the United States Bureau of Fisheries at Hornbrook, on Klamath River, in 1913. At first this hatchery was devoted to rainbow-trout work, but later the collection and distribution of silver and chinook salmon was taken up.

During the fall of 1911 the State established an experimental station at Sacramento in order to carry on a series of experiments to determine whether the eggs of the quinnat salmon could be successfully hatched and the fry reared near the city of Sacramento. Of the fish hatched at this station 50,000 were marked.

Nearly all of the fry that were liberated in the Sacramento River were floated in a screen cage by boat into the middle of the stream and there released. N. B. Scofield took 500 in a floating box down the river, where they were held and fed for several weeks in brackish and salt water. They were apparently not affected by the changes in the salinity of the water.

Experiments were carried on until the summer of 1913, when they were abandoned due to the killing of the embryos by the mineral substances in the water used at the station.

During the fiscal year 1912 the Mill Creek hatchery of the United States Bureau of Fisheries was operated by the California Commission.

Some years ago the town of Ukiah, Mendocino County, established a hatchery 1 mile from the town, and on Russian River. For some years it was operated as a trout station, but eventually became an important steelhead hatchery. It was not operated in 1913. In 1914 the State Fish Commission collected steelhead eggs at the Eel River dam of the Snow Mountain Water & Power Co., and having secured permission from the town of Ukiah, hatched them out in its hatchery.

As the Hornbrook hatchery on Klamath River was on private property, the United States Bureau of Fisheries in 1915 removed the buildings from the old location on the south side to property owned by the Government on the north side of the river.

In 1915 new hatchery buildings were erected at the Mill Creek hatchery.

In 1917 the State of California began operations for the collection of salmon eggs at Klamathon, on the Klamath River. This station was previously operated by the Bureau of Fisheries and has been operated with fair success to the present time. The eggs taken have been hatched at the Mount Shasta and Fall Creek hatcheries. The Fall Creek hatchery began operations in 1920, and is located on Fall Creek, a tributary of the Klamath in Siskiyou County.

Silver-salmon eggs have been taken at the Prairie Creek hatchery and hatched at the Fort Seward and Prairie Creek hatcheries in Humboldt County, beginning in 1928. The Prairie Creek hatchery is located in Humboldt County and began operations in the fall of 1927.

OUTPUT

The following tables show separately the quantity of salmon eggs, fry, fingerlings, yearlings, and adults distributed by the United States Bureau of Fisheries and by the State since the inception of the work. The large quantity of eggs shown by the bureau represents largely the eggs supplied to the State, which hatched and distributed them, and eggs sent to other States and to foreign countries.

Output of hatcheries in California owned by the United States Bureau of Fisheries

Year ending June 30 [1]—	Chinook			Silver		
	Eggs	Fry	Fingerlings, yearlings, and adults	Eggs	Fry	Fingerlings, yearlings, and adults
1872	30,000					
1873	1,400,000					
1874	4,155,000	850,000				
1875	6,250,000	1,750,000				
1876	5,065,000	1,500,000				
1877	4,983,000	2,000,000				
1878	7,810,000	2,500,000				
1879	4,250,000	2,300,000				
1880	3,800,000	2,000,000				
1881	4,300,000	3,100,000				
1882		3,991,750				
1883		776,125				
1889 [2]	3,450,000	1,500,000				
1890	1,554,000	84,000				
1891	2,988,000	777,000				
1892	2,902,000	315,500				
1893	3,530,000	1,190,100				
1894	7,500,000	438,500			280,000	
1895	3,676,000	500,000			690,000	560,000
1896	6,170,800	715,700				
1897	18,232,590	3,056,701			298,137	
1898	30,605,000	15,643,300				
1899	27,665,000	3,275,110				
1900	2,925,000	3,533,950				
1901	3,934,036	889,570				
1902	17,580,410	2,115,560				
1903	11,275,777	1,618,066				
1904	64,598,354	2,350,130				
1905	96,025,765	7,561,380				
1906	107,905,945	3,496,267	138			
1907	73,376,315	2,512,256				
1908	64,990,550	4,780,855				
1909	32,278,265	3,590,078				
1910	30,539,467	2,286,257				
1911	33,364,514	3,666,061		2,289,900		
1912	20,697,550	7,243,325				
1913	17,092,873	2,195,100		100,000	17,320	
1914	25,373,645	5,598,349	3,849,991	95,840	2,536,460	
1915	20,716,005	5,015,400	8,086,139		971,740	226,162
1916	19,622,340	9,940,950	11,938,224		2,169,050	
1917	7,027,300	800,000	14,628,300		50,000	11,000
1918	14,421,900		10,689,400			
1919	11,802,500		10,287,800			
1920	4,235,000		7,235,000			
1921	3,000,000		4,593,400			
1922			5,872,200			
1923			3,804,400			
1924		1,050,000	4,486,000			
1925		2,148,800	1,892,500			
1926	25,000	800,000	5,327,700			
1927			9,305,000			
1928	954,000		6,559,700			
Total	834,078,901	121,456,134	108,555,892	2,485,740	7,012,707	797,162

[1] Calendar year was used up to 1889. [2] The hatchery was closed from 1884 to 1888.

Output of hatcheries in California owned by the United States Bureau of Fisheries—Continued

Year ending June 30[1]—	Steelhead trout			Total		
	Eggs	Fry	Fingerlings, yearlings, and adults	Eggs	Fry	Fingerlings, yearlings, and adults
1872				30, 000		
1873				1, 400, 000		
1874				4, 155, 000	850, 000	
1875				6, 250, 000	1, 750, 000	
1876				5, 065, 000	1, 500, 000	
1877				4, 983, 000	2, 000, 000	
1878				7, 810, 000	2, 500, 000	
1879				4, 250, 000	2, 300, 000	
1880				3, 800, 000	2, 000, 000	
1881				4, 300, 000	3, 100, 000	
1882					3, 991, 750	
1883					776, 125	
1889[2]				3, 450, 000	1, 500, 000	
1890				1, 554, 000	84, 000	
1891				2, 988, 000	777, 000	
1892				2, 902, 000	315, 500	
1893				3, 530, 000	1, 190, 100	
1894	75, 000	308, 500		7, 575, 000	1, 027, 000	
1895		852, 500	332, 000	3, 676, 000	2, 042, 500	892, 000
1896	175, 000	107, 808		6, 345, 800	823, 508	
1897	50, 000	257, 000		18, 282, 590	3, 611, 838	
1898	60, 000	650, 000		30, 665, 000	16, 293, 300	
1899				27, 665, 000	3, 275, 110	
1900				2, 925, 000	3, 533, 950	
1901				3, 934, 036	889, 570	
1902				17, 580, 410	2, 115, 560	
1903				11, 275, 777	1, 618, 066	
1904				64, 598, 354	2, 350, 130	
1905				96, 025, 765	7, 561, 380	
1906				107, 905, 945	3, 496, 267	138
1907				73, 376, 315	2, 512, 250	
1908				64, 990, 550	4, 780, 855	
1909				32, 278, 265	3, 590, 078	
1910				30, 539, 467	2, 286, 257	
1911				35, 654, 414	3, 666, 061	
1912				20, 697, 550	7, 243, 325	
1913				17, 192, 873	2, 212, 420	
1914				25, 469, 485	8, 134, 809	3, 849, 991
1915				20, 716, 005	5, 987, 140	8, 312, 301
1916				19, 622, 340	12, 110, 000	11, 938, 224
1917				7, 027, 300	850, 000	14, 639, 300
1918				14, 421, 900		10, 689, 400
1919				11, 802, 500		10, 287, 800
1920				4, 235, 000		7, 235, 000
1921				3, 000, 000		4, 593, 400
1922						5, 872, 200
1923						3, 804, 400
1924					1, 050, 000	4, 486, 000
1925					2, 148, 800	1, 892, 500
1926				25, 000	800, 000	5, 327, 700
1927						9, 305, 000
1928				954, 000		6, 559, 700
Total	360, 000	2, 175, 808	332, 000	836, 924, 641	130, 644, 649	109, 685, 054

[1] The calendar year was used up to 1889. [2] The hatchery was closed from 1884 to 1888.

Output of hatcheries owned by the State of California

Year	Chinook		Silver fry	Steelhead fry	Total	
	Eggs	Fry [1]			Eggs	Fry
1873		520, 000				520, 000
1874		850, 000				850, 000
1875	[2] 250, 000	2, 250, 000			250, 000	2, 250, 000
1876		2, 000, 000				2, 000, 000
1877		2, 200, 000				2, 200, 000
1878		2, 500, 000				2, 500, 000
1879		2, 300, 000				2, 300, 000
1880		2, 225, 000				2, 225, 000
1881		2, 420, 000				2, 420, 000
1882		3, 991, 750				3, 991, 750
1884		600, 000				600, 000
1886		150, 000				150, 000
1887		200, 000				200, 000
1888		1, 290, 000				1, 290, 000
1889		2, 168, 000				2, 168, 000
1890		1, 320, 000				1, 320, 000
1891		2, 798, 000				2, 798, 000
1892		2, 651, 000				2, 651, 000
1893		3, 941, 650				3, 941, 650
1894		7, 776, 400				7, 776, 400
1895		3, 435, 000				3, 435, 000
1896		15, 283, 183				15, 283, 183
1897		18, 123, 000				18, 123, 000
1898		31, 476, 388				31, 476, 388
1899		21, 234, 000				21, 234, 000
1900		2, 536, 000				2, 536, 000
1901		3, 239, 000				3, 239, 000
1902		16, 852, 040		301, 000		17, 153, 040
1903		20, 040, 487		120, 000		20, 160, 487
1904		63, 632, 000		90, 000		63, 722, 000
1905		87, 000, 000		108, 000		87, 108, 000
1906		105, 815, 920		243, 000		106, 058, 920
1907		71, 267, 000		352, 000		71, 619, 000
1908		60, 619, 000		170, 000		60, 789, 000
1909		28, 000, 000		517, 000		28, 517, 000
1910		28, 469, 745		637, 800		29, 107, 545
1911		29, 657, 263	2, 060, 910	1, 858, 100		33, 576, 273
1912		18, 909, 445		2, 177, 958		21, 087, 403
1913		16, 277, 227	25, 000	1, 983, 500		18, 285, 727
1914		25, 290, 615	12, 500	3, 171, 083		28, 474, 198
1915		33, 313, 150	1, 417, 000	8, 582, 500		43, 312, 650
1916		19, 339, 738		5, 213, 170		24, 552, 908
1917		6, 853, 000		6, 699, 420		13, 552, 420
1918		14, 439, 000		4, 483, 000		18, 922, 000
1919		11, 970, 000	178, 000	4, 950, 000		17, 098, 000
1920		12, 326, 200		4, 718, 000		17, 044, 200
1921		8, 644, 000		1, 859, 000		10, 503, 000
1922		9, 393, 000		4, 592, 000		13, 985, 000
1923		17, 639, 430		3, 281, 300		20, 920, 730
1924		17, 856, 120		9, 730, 000		27, 586, 120
1925		5, 576, 370		2, 243, 290		7, 819, 660
1926		8, 580, 780		3, 683, 610		12, 264, 390
1927		16, 911, 590		3, 591, 810		20, 503, 400
1928		9, 817, 000		5, 442, 275		15, 259, 275
Total	250, 000	903, 968, 491	3, 693, 410	80, 798, 816	250, 000	988, 460, 717

[1] The greater part of the output of chinook fry was from eggs supplied by the U. S. Bureau of Fisheries hatcheries in California.
[2] All were lost.

DISTRIBUTION

The following table shows, by streams and species, the distribution in California of the salmon eggs, fry, fingerlings, yearlings, and adults, from the hatcheries of the United States Bureau of Fisheries and the State. This far from represents the work of the hatcheries, as large quantities of eggs were sent to other States and foreign countries.

Distribution of salmon in the waters of California, 1873–1919

Year	Klamath River and tributaries				Redwood Creek and tributaries			
	Chinook		Silver		Chinook fry	Silver		Steelhead fry
	Fry	Yearlings	Fry	Yearlings and adults		Fry	Yearlings and adults	
1890	90,000							
1891	30,000				25,000			
1892	147,600	25,000			142,500			
1893	487,200				170,000			
1895			300,000	160,000		140,000	400,000	
1896					65,700			107,808
1897					280,250	124,750		202,000
1898	16,000				1,260,000			650,000
1903	40,000							
1911			2,060,910					
1913			17,320					
1914	2,155,100		2,548,960					
1915	5,820,000		1,098,000					
1916	7,733,135		2,169,050					
1917	1,728,000	368,000	50,000	11,000				
1918	3,675,000							
1919	1,148,000		178,000					
Total	23,070,035	393,000	8,422,240	171,000	1,943,450	264,750	400,000	959,808

Year	Mad River and North Fork			Eel River		Russian River	Skaggs Springs	Marin County creeks
	Chinook fry	Silver fry	Steelhead fry	Chinook fry	Steelhead fry	Chinook fry		
1881						15,000	15,000	
1894		280,000	308,500					
1895		470,000						
1897	145,365	173,387	60,000					635,000
1898				7,857,388				1,970,000
1899				8,202,000				900,000
1900				885,000				
1902				2,069,500	301,000			
1903				5,257,947	120,000			
1904				5,200,000	90,000			
1905				8,100,000				
1906				9,265,920	243,000			
1907				7,570,000	352,000	25,000		25,000
1908				6,154,000				
1909				5,500,000	349,000			
1910				5,969,745	334,800			
1912	100,000			3,103,660				
1913	100,000			1,386,500				
1914	225,000			3,723,000				
1915	350,000			2,618,150				
1917	400,000			91,000				
1918	250,000			844,000				
1919	250,000			682,000				
Total	1,820,365	923,387	368,500	84,479,810	1,789,800	40,000	15,000	3,530,000

Distribution of salmon in the waters of California 1873–1919—Continued

Year	Sacramento River and tributaries					San Francisco Bay streams	Smith River	Santa Ynez River	Monterey Bay and tributaries
	Chinook			Silver fry	Steelhead fry	Chinook fry			
	Eggs	Fry	Yearlings, fingerlings, and adults						
1873	20,000	520,000							
1874		850,000							
1875	[1] 250,000	2,000,000							
1876		2,000,000							
1877		2,200,000							
1878		2,500,000							
1879		2,300,000							
1880		2,225,000							
1881		[2] 2,300,500				20,000			30,000
1882	80,300	3,991,750							
1884		600,000							
1886		150,000							
1887		200,000							
1888		1,290,000							
1889		3,668,000							
1890		1,404,000							
1891		3,520,000							
1892		2,676,500							
1893		4,474,750							
1894		8,214,900			45,000				
1895		3,935,000							
1896		15,683,183	250,000						
1897		19,264,086							
1898		33,998,300							
1899	85,200	16,307,110							
1900		5,184,950							
1901		4,128,570							
1902		16,898,100							
1903		16,359,606							
1904		60,782,130							
1905		94,561,380			108,000				
1906		100,038,552							900,000
1907		66,209,250			135,000				1,200,000
1908		59,245,855			170,000				800,000
1909		26,090,000			168,000				
1910		24,786,257			303,000				
1911		33,323,324							
1912		22,949,110							
1913		16,691,167				294,660			
1914		24,637,864	838,906				100,000		
1915		[3] 28,688,000	9,053,635	1,194,762				42,000	
1916		26,800,604	5,538,224				300,000	25,000	
1917		5,875,000	14,260,300					25,000	
1918		9,470,000	10,689,400				100,000	25,000	
1919		9,840,000	10,287,000					25,000	
Total	435,500	788,832,798	50,917,465	1,194,762	929,900	314,660	500,000	142,000	2,930,000

[1] All were lost.

[2] Includes 15,000 chinook fry planted in San Gregorio River and 15,000 chinook fry planted in Pescadero Creek.

[3] Includes the following plants in Santa Barbara county streams: Bear Creek, 4,000; Maguelito Creek, 2,000; and Salispuedes Creek, 2,000.

Distribution of salmon in the waters of California 1873–1919—Continued

Year	Monterey Bay and tributaries	Ventura River	Truckee River	Total					
				Chinook			Silver		
	Silver fry	Chinook fry		Eggs	Fry	Yearlings, fingerlings, and adults[4]	Fry	Adults and yearlings	Steelhead fry [5]
1873				20,000	520,000				
1874					850,000				
1875			250,000	250,000	2,250,000				
1876					2,000,000				
1877					2,200,000				
1878					2,500,000				
1879					2,300,000				
1880					2,225,000				
1881			10,000		2,390,500				
1882				80,300	3,991,750				
1884					600,000				
1886					150,000				
1887					200,000				
1888					1,290,000				
1889					3,668,000				
1890					1,494,000				
1891					3,575,000				
1892					2,966,600	25,000			
1893					5,131,950				
1894					8,214,900		280,000		353,500
1895					3,935,000		910,000	560,000	
1896					15,748,883	250,000			107,808
1897					20,324,701		298,137		262,000
1898					45,101,688				650,000
1899				85,200	25,409,110				
1900					6,069,950				
1901					4,128,570				
1902					18,967,600				301,000
1903					21,657,553				120,000
1904					65,982,130				90,000
1905					102,661,380				108,000
1906					110,204,472				243,000
1907	80,000				75,029,250		80,000		487,000
1908	80,000				66,199,855		80,000		170,000
1909	[6] 54,000				31,590,000		42,000		518,200
1910					30,756,002				637,800
1911					33,323,324		2,060,910		1,858,100
1912					26,152,770				2,177,958
1913	25,000				18,472,327		42,320		1,983,500
1914					30,840,964	838,906	2,548,960		3,171,083
1915	71,000	25,000			37,543,150	9,053,635	2,363,762		8,582,500
1916		25,000			34,883,739	5,538,224	2,169,050		5,213,170
1917		25,000			8,144,000	14,628,300	50,000	11,000	6,699,420
1918		25,000			14,389,000	10,689,400			
1919		25,000			11,970,000	10,287,000	178,000		4,950,000
Total	310,000	125,000	260,000	435,500	908,003,118	51,310,465	11,103,139	571,000	38,684,039

[4] Of recent years it has been impossible to show the total number of yearlings, fingerlings, and adults planted, as the State reports do not distinguish them from the fry. Those shown in 1914–1919 were reared by the U. S. Bureau of Fisheries.

[5] After 1911 the practice of showing waters in which steelheads were planted was abandoned as the number of streams was becoming unwieldy.

[6] Includes 1,200 steelhead fry, which in "Total" column are included under "Steelhead fry."

After 1919 it was found impossible to show, by streams and species, the distribution in California of salmon and steelhead trout, as the State authorities had abandoned printing the data in this way and substituted that of showing it by counties. The following table shows the total plantings in this manner from 1920 to 1928, both inclusive:

Distribution of salmon in California, 1920—1928

Year	Chinook			Steelhead	Total		
	Eggs	Fry	Fingerlings, yearlings, and adults	Fry	Eggs	Fry	Fingerlings, yearlings, and adults
1920	4, 235, 000	[1] 12, 326, 200	7, 235, 000	4, 614, 100	4, 235, 000	16, 940, 300	7, 235, 000
1921	3, 000, 000	8, 644, 000	4, 593, 400	1, 859, 000	3, 000, 000	10, 503, 000	4, 593, 400
1922		9, 393, 000	5, 872, 200	4, 592, 000		13, 985, 000	5, 872, 200
1923		17, 639, 430	3, 804, 400	3, 281, 300		20, 920, 730	3, 804, 400
1924		18, 906, 120	4, 486, 000	9, 730, 000		28, 636, 120	4, 486, 000
1925		7, 725, 170	1, 892, 500	2, 243, 290		9, 968, 460	1, 892, 500
1926	25, 000	9, 380, 000	5, 327, 700	3, 683, 610	25, 000	13, 063, 610	5, 327, 700
1927		16, 911, 590	9, 305, 000	3, 591, 810		20, 503, 400	9, 305, 000
1928	954, 000	9, 817, 000	6, 559, 700	5, 442, 275	954, 000	15, 259, 275	6, 559, 700
Total	8, 214, 000	110, 742, 510	49, 075, 900	39, 037, 385	8, 214, 000	149, 779, 895	49, 075, 900

[1] Includes 178,000 silver salmon fry.

OREGON

HATCHERIES ON COASTAL STREAMS

Rogue River.—In 1877 R. D. Hume, who had been packing salmon on this river for some years, erected a hatchery at Ellensburg. In 1888 the Oregon Legislature appropriated a sum of money for the enlargement and support of this hatchery, Mr. Hume to retain complete control. As the location is on tidewater, it is necessary to catch the parent fish and hold them until they are ready to spawn, and in order to do this Mr. Hume had an excavation 32 by 62 feet and 11 feet deep made in the bank of the river. This was lined with concrete 1 foot thick, which, when filled with water, made a pond 30 by 60 feet and 10 feet deep. Over the entire pond he constructed a building which could be closed up so as virtually to exclude the light. It is supposed that retaining the fish in a dark place aids in keeping them in good physical condition until ready to spawn. After the death of Mr. Hume in 1908 this hatchery was taken over and operated by the State. After a closure of four years it was reopened as a feeding station in 1912.

In 1897 Mr. Hume built and equipped a hatchery on the upper Rogue River at the mouth of Elk Creek about 26 miles from the town of Central Point, in Jackson County, and, in pursuance of an understanding with the United States Fish Commission, the latter operated then and still continues to operate this plant.

In 1900 the Government established an auxiliary station for the collection of steelhead trout eggs on Elk Creek, about 10 miles above the main station. In 1905 a substation was operated at Grants Pass, while during the fiscal year 1908 and in subsequent years substations were operated at Findley Eddy, on the Rogue River, Illinois River, and Applegate Creek, tributaries of the Rogue.

Many of the eggs gathered at the upper Rogue River stations were shipped to Mr. Hume's hatchery, on the lower river, and there hatched out and planted.

Coquille River.—The State formerly had a hatchery on this river, but it was abandoned during the winter of 1902–3. In the winter of 1904–5 a substation was established on one of the tributaries of the Coquille River, about 6 miles from the South Coos River hatchery, and was used in hatching eggs brought to it from the latter place. A station was built on the north fork of the Coquille River in 1910.

Coos River.—A hatchery was built by the State in 1900 on the South Coos River, about 20 miles from the town of Marshfield.

Umpqua River.—In 1900 the State built a hatchery on the north fork of the Umpqua River, near the town of Glide and about 24 miles east of Roseburg. In 1901 a station was established farther up the north fork, at the mouth of Steamboat Creek. After working here two years the station was moved a couple of miles farther up the stream. In 1907 work was resumed again at the original station near Glide, as winter freshets had seriously damaged the upper station. A permanent station was built in 1910.

Siuslaw River.—In 1893 the State erected a hatchery on Knowles Creek, a tributary of the Siuslaw River, about 20 miles above the mouth of the river. It was turned over to the United States Fish Commission to operate, but no fish came up to the hatchery because the fishermen lower down stretched their nets entirely across the river.

In 1897 and 1898 the United States Fish Commission operated a hatchery owned by a Mr. McGuire and located close to Mapleton, about 2 miles below the head of tidewater.

In 1902 the State established an experimental station at the Bailey place, near Meadow post office. In 1907, a permanent station was established by the State on Land Creek fork of the Siuslaw River.

Alsea River.—In 1902 the State established a station on the Willis Vidito place, near the town of Alsea. In 1907 an experimental station was established on this river at the mouth of Rock Creek, about 14 miles above the head of tidewater. In 1910 an experimental station was established between Alsea and tidewater.

Yaquina River.—In 1902 the State established a hatching station on the Big Elk River, a tributary of Yaquina River, about 3 miles above its confluence with the main river. This station was abandoned in 1924.

Tillamook Bay.—In 1902 the State established a station on Wilson River, a tributary of Tillamook Bay, and about 8 miles above tidewater. In 1906 the station was removed to the Trask River, a tributary of Tillamook Bay.

Additional plants were established at Nehalem in 1919, and Alsea, near Tidewater, in 1912. Two new egg-collecting stations at Nestucca and Wilson River were created in 1912. The latter was temporarily discontinued.

DISTRIBUTION

The following table shows the distribution of fry and fingerlings in the coastal streams of the State by the Government and the State.

Distribution of salmon in the coastal streams of Oregon

Year ending June 30—	Tillamook Bay and tributaries			Yaquina River			Alsea River		
	Chinook fry	Silver-side fry	Steel-head fry	Chinook fry	Silver-side fry	Steel-head fry	Chinook fry	Silver-side fry	Steel-head fry
1898	19,994								
1901				213,500					
1903	251,875			557,700			67,750		
1904	799,300			3,144,380	985,220				
1905				1,407,470	3,009,075	780,500	1,000,000	1,000,000	
1906				816,608	4,178,000	1,033,150	806,938	1,785,351	
1907	312,700	2,648,000		1,919,508	1,955,793	376,245			
1908	2,124,000	1,629,000		2,193,043	909,855		199,700	812,300	
1909		4,896,000	569,690	485,500	1,006,309				
1910	624,800	3,506,990	2,309,770	324,038	28,815				
1911	1,818,245	1,080,000	1,196,000	582,785	2,637,550	621,015	495,950	30,300	
1912	646,300	1,578,131	761,000	148,992	1,554,602	7,145	287,645	997,455	
1913	1,747,530	422,886	848,229	727,567	3,288,650		87,935	424,925	
1914	487,692	1,112,392	660,588						
1915	2,833,428		213,900						
1916	[1]1,982,724	[1]130,130					[1]646,431		
1917	2,143,430	183,800	495,090				1,373,100	1,649,830	1,495,315
1918	1,442,400	534,600					869,370	1,107,483	
1919	705,656	2,097,442	384,370				1,151,720	1,872,473	1,753,104
1920	1,077,090	1,070,135	826,995				1,295,375	1,706,650	3,707,300
1921	1,362,780	1,785,485	1,051,150				3,019,870	6,859,321	
1922			2,036,000				1,311,305	4,783,435	2,397,869
1923	1,529,306	805,987					1,346,361	1,609,761	4,306,533
1924	3,114,848	3,546,649	1,134,460	[2]1,467,010			3,165,534	1,076,936	2,153,596
1925	5,323,668	1,888,350	820,900		293,125		2,562,333	4,487,800	3,250,214
1926	12,731,300	8,411,200	3,197,350	517,288	966,425		2,301,047	2,766,291	6,060,294
1927	6,177,121	4,280,100	2,370,900	887,850	1,091,670		769,528	5,585,378	2,737,226
1928	2,852,120	2,144,482	545,070				1,770,514	3,534,517	1,615,134
Total	52,108,367	43,751,759	19,421,462	15,393,239	21,905,089	2,818,055	24,528,406	42,089,206	29,476,585

Year ending June 30—	Siuslaw River			Umpqua River		Coos Bay and tributaries		
	Chinook fry	Silverside fry	Steelhead fry	Chinook fry	Steelhead fry	Chinook fry	Silverside fry	Steelhead fry
1897	180,000							
1898	440,275							
1899	2,700,000							
1901	213,500			730,000		235,000		
1902	112,000	214,800		1,136,000		2,416,350		
1903	389,239			1,596,213				
1904	822,567			1,399,860		4,079,274		
1905	435,162	311,900		2,654,925		3,877,172		
1906	1,826,531	1,296,732	397,355	4,903,700		2,744,000		
1907	608,949	1,030,486		4,685,900		4,014,400		
1908	729,130	1,127,293		2,378,853		3,000,000		
1909	191,267	1,092,540	98,243	4,093,848		2,084,500	1,032,000	222,000
1910	273,352	25,289		5,686,273		1,683,738		
1911	594,702	20,693	227,580	2,541,236	293,996	2,374,200		
1912	715,758	504,429	72,097	1,053,516		1,767,170	2,317,370	
1913	255,028	627,312	106,717	903,704	181,085	1,281,120	962,528	
1914	1,062,546	476,273	17,735	1,882,985	80,000	1,331,217	2,973,390	
1915	1,472,410		257,850	1,333,171		1,212,805	1,551,645	192,625
1916	[1]972,395			[1]1,216,518		[1]2,236,229	[1]2,492,217	
1917	984,945	153,662		918,622	65,200	2,370,000	1,089,500	
1918	529,904	147,475		1,402,700		1,208,840	1,193,960	
1919	743,057			3,259,258		1,932,210	2,416,680	
1920	738,182		100,595	3,896,439		976,600		
1921	614,735	574,620		2,715,075		1,316,780	2,423,530	
1922		1,670,867		2,088,590		2,174,290	1,636,420	
1923	1,000,000			994,848		3,013,810	2,869,610	
1924	761,819	1,591,424		2,466,243	[3]282,915	[4]6,284,035	1,237,950	858,100
1925	1,137,160			3,236,539	431,069	3,062,490	1,736,600	490,760
1926	629,900	1,488,614	612,875	2,714,500	[5]2,280,348	3,541,110	3,246,387	252,820
1927	440,300	805,400		3,879,500	[6]1,045,113	1,919,100	2,193,320	660,740
1928			333,000	4,018,968	802,072	1,881,100	1,467,200	392,665
Total	21,574,813	13,159,809	2,224,047	69,787,984	2,439,383	64,017,540	32,840,307	3,069,710

[1] All fingerlings.
[2] Includes 423,607 humpbacks reported by game commission and 1,043,403 humpbacks from Yaquina River.
[3] 282,915 silverside fry.
[4] 1,670,867 reported by the Oregon Game Commission.
[5] Includes 1,990,500 silverside fry.
[6] Includes 749,000 silverside fry.

Distribution of salmon in the coastal streams of Oregon—Continued

Year ending June 30—	Coquille River		Rogue River and tributaries			
			Chinook			
	Chinook fry	Silverside fry	Fry	Yearlings, fingerlings, and adults	Silverside fry	Steelhead fry
1877			50,000			
1898			1,910,045			
1900			2,156,945			
1901	235,000		2,967,058		128,000	65,850
1902			4,750,763		424,530	20,250
1903	3,084,577		3,480,300		680,800	
1904	1,000,000		9,023,428			8,073
1905	2,210,000		4,758,653		1,250,432	531,000
1906	2,978,700		47,500	75,000		12,625
1907	2,840,000		5,880,290		1,375,000	105,300
1908	2,450,000	226,600	6,597,027	170,051	158,000	937,680
1909		1,185,800	771,710		643,000	878,847
1910			1,430,292			89,850
1911	500,000	980,770	1,364,248		501,081	2,592,665
1912	196,855	1,672,850	9,574,340		2,355,885	[7] 1,313,890
1913	496,680	962,528	4,169,150		3,198,346	2,795,075
1914	491,580	1,331,910	3,752,483		[8] 7,832,000	1,376,308
1915	495,333	1,365,815	4,747,623	9,309	2,336,359	[9] 3,908,699
1916	[1] 1,465,321	[1] 1,451,858	2,515,500	2,517,892	[10] 198,103	[11] 3,083,092
1917	1,100,500	674,293	171,500	1,758,800	[12] 399,700	[13] 561,955
1918	1,219,628	1,098,650		900,750	366,500	2,810,700
1919	1,491,210	1,469,440		1,032,950	592,150	807,000
1920						
1921	890,630	1,340,880				382,000
1922						2,644,427
1923						
1924	498,482	1,994,020				
1925			1,977,511		40,000	1,021,010
1926	995,000	1,975,000	2,720,000		98,689	
1927		794,500	1,994,208			840,511
1928		798,040	1,220,000			821,179
Total	24,639,496	19,322,954	78,030,574	6,464,752	22,578,575	27,607,986

[1] All fingerlings.
[7] Includes 177,790 fingerlings, yearlings, and adults.
[8] Includes 860,903 fingerlings, yearlings, and adults.
[9] Includes 27,258 fingerlings.
[10] Includes 9,153 fingerlings.
[11] Includes 2,583,092 fingerlings; all were planted by U. S. Bureau of Fisheries.
[12] Includes 6,000 fingerlings.
[13] Includes 128,600 fingerlings.

Distribution of salmon in the coastal streams of Oregon—Continued

Year ending June 30—	Total				Grand total, all species
	Chinook		Silverside fry	Steelhead fry	
	Fry	Yearlings, fingerlings, and adults			
1877	50,000				50,000
1897	180,000				180,000
1898	2,370,314				2,370,314
1899	2,700,000				2,700,000
1900	2,156,945				2,156,945
1901	4,594,058		128,000	65,850	4,787,908
1902	8,415,113		639,330	20,250	9,074,693
1903	9,427,654		680,800		10,108,454
1904	20,268,809		985,220	8,073	21,262,102
1905	16,343,382		5,571,407	1,311,500	23,226,289
1906	14,123,977	75,000	7,260,083	1,443,130	22,902,190
1907	20,261,747		7,009,279	481,545	27,752,571
1908	19,671,753	170,051	4,863,048	937,680	25,642,532
1909	7,626,825		9,855,649	1,768,780	19,251,254
1910	10,022,493		3,561,094	2,399,620	15,983,207
1911	10,271,366		5,250,394	4,931,256	20,453,016
1912	14,390,576		10,980,722	2,154,132	27,525,430
1913	9,668,714		9,887,175	3,931,106	23,486,995
1914	9,008,503		13,725,965	2,134,631	24,869,099
1915	12,094,770	9,309	5,253,819	4,573,074	21,930,972
1916	2,515,500	11,037,510	4,272,308	3,083,092	20,908,410
1917	9,062,097	1,758,800	4,150,785	2,617,560	17,589,242
1918	6,672,842	900,750	4,448,668	2,810,700	14,832,960
1919	9,283,111	1,032,950	8,448,185	2,944,474	21,708,720
1920	7,983,638		2,775,785	4,634,890	15,394,313
1921	9,919,870		12,983,836	1,433,150	24,336,856
1922	5,574,185		8,090,722	7,078,296	20,743,203
1923	7,884,385		5,285,358	4,306,533	17,476,276
1924	17,757,971		9,729,894	4,146,156	31,634,021
1925	17,299,701		8,445,875	6,013,953	31,759,529
1926	26,150,145		20,943,106	10,413,187	57,506,438
1927	16,067,607		15,499,368	6,905,490	38,472,465
1928	11,742,702		7,944,239	4,509,120	24,196,061
Total	341,560,753	14,984,370	198,670,114	87,057,228	642,272,465

The following tables show separately the total output of the hatcheries in Oregon owned by the United States Bureau of Fisheries and of those owned by the State:

Output of hatcheries in Oregon owned by the United States Bureau of Fisheries

Year ending June 30—	Chinook			Silverside		
	Eggs	Fry	Fingerlings, yearlings, and adults	Eggs	Fry	Fingerlings, yearlings, and adults
1889		4,500,000				
1890	1,000,000	2,776,475				
1891	700,000	4,901,525				
1892		1,332,400				
1893		4,100,000				
1894		213,000				
1895	23,000					
1896		[1] 2,852,150	[2] 557,150			
1897		4,922,634				
1898		16,915,512				
1899	27,000	4,300,200				
1900	1,800,000	4,126,367			146,824	
1901	1,100,000	1,669,857	1,668		128,000	
1902	1,866,000	11,587,061			424,530	
1903	4,884,400	5,453,860	250	680,800		
1904	3,113,000	15,270,675				
1905	?0,000	9,822,636			1,250,432	
1906	28,200	2,454,371	122,980			300
1907	1,661,390	8,542,104				
1908	2,045,000	7,844,827	627,856		158,000	57,952
1909	3,531,000	5,021,655	2,763		1,799,915	
1910	3,953,992	4,220,197	225			
1911	600,000	5,686,168	200,000		1,659,681	
1912	8,000,000	12,837,840	750,765		2,355,885	
1913	21,491,000	11,291,023			3,198,346	
1914	1,075,000	12,156,818	602,300		8,441,642	27,258
1915	37,000	10,434,517	531,351	76,200	2,373,559	
1916	1,000,000	9,916,900	3,556,161	196,000	488,950	9,153
1917	163,900	634,500	7,364,500		393,700	92,100
1918	3,000	3,843,700	11,284,150		8,000	385,300
1919	20,000		5,325,450			594,350
1920	30,000	1,250,100	[3] 6,674,100			20,500
1921	130,000		[4] 12,618,400			417,050
1922	20,000	1,311,500	[5] 11,759,650			110,000
1923	200,000	716,000	[6] 6,518,200			2,833,600
1924	10,539,100	[7] 448,000	[8] 16,075,000			7,558,150
1925			[9] 8,214,400	762,000		2,081,000
1926	520,000		[10] 18,218,000	10,000		2,685,500
1927			[11] 12,051,000	48,000		640,900
1928			[12] 11,590,500	925,000		1,369,500
Total	69,591,982	193,334,572	134,646,819	2,698,000	22,827,464	18,862,593

[1] All but 17,000 of these were from eggs received from the California stations.
[2] All raised from eggs received from the California stations.
[3] Includes 95,000 chum salmon.
[4] Includes 1,935,500 from Idaho.
[5] Includes 224,000 from Idaho.
[6] Includes 1,124,700 from Idaho, and 95,000 chums.
[7] All from Idaho waters.
[8] Includes 7,600 chums and 23,700 sockeyes.
[9] Includes 46,700 sockeyes.
[10] Includes 10,970,000 from Idaho, and also 64,000 sockeyes.
[11] Includes 7,879,000 from Idaho.
[12] Includes 7,349,500 from Idaho; and 71,000 sockeyes.

Output of hatcheries in Oregon owned by the United States Bureau of Fisheries—Continued

Year ending June 30—	Steelhead trout			Total		
	Eggs	Fry	Fingerlings, yearlings, and adults	Eggs	Fry	Fingerlings, yearlings, and adults
1889					4, 500, 000	
1890				1, 000, 000	2, 776, 475	
1891				700, 000	4, 901, 525	
1892					1, 332, 400	
1893					4, 100, 000	
1894					213, 000	
1895				23, 000		
1896					2, 832, 150	557, 150
1897					4, 922, 634	
1898					16, 915, 512	
1899	159, 000	12, 125		186, 000	4, 312, 325	
1900	415, 000	99, 000		2, 215, 000	4, 372, 191	
1901	246, 000	65, 850	25, 000	1, 346, 000	1, 863, 707	26, 668
1902	481, 000	20, 250		2, 347, 000	12, 031, 841	
1903	400, 000	262, 700	62, 033	5, 965, 200	5, 716, 560	62, 283
1904		23, 205	11, 090	3, 113, 000	15, 293, 880	11. 090
1905	50, 000	534, 000		80, 000	11, 607, 068	
1906	10, 000	1, 294, 485	40, 383	38, 200	3, 748, 856	163, 663
1907	50, 000	105, 300		1, 711, 390	8, 647, 404	
1908	263, 725	952, 680		2, 308, 725	8, 955, 507	685, 788
1909	51, 468	1, 374, 308		3, 582, 468	8, 195, 878	2, 763
1910		2, 074, 188		3, 953, 992	6, 294, 385	225
1911		2, 914, 789		600, 000	10, 260, 638	200, 000
1912		2, 005, 100	294, 090	8, 000, 000	17, 198, 825	1, 044, 855
1913		2, 795, 075		21, 491, 000	17, 284, 444	
1914		2, 230, 008		1, 075, 000	22. 828, 468	629, 558
1915	752, 000	3, 254, 275	910, 652	865, 200	16, 062, 351	1, 442, 003
1916	450, 000	500, 000	2, 785, 805	1, 646. 000	10, 905, 850	6. 351, 119
1917	2, 687, 600	34, 500	467. 450	2, 851, 500	1, 062, 700	7, 924, 050
1918	750, 000		3, 372, 165	753, 000	3, 851, 700	15, 041, 615
1919	525, 000		843, 000	545, 000		6, 762, 800
1920	700, 000		2, 062, 250	730, 000	1, 250, 100	8, 756, 850
1921			1, 316, 000	130, 000		14, 351, 450
1922	200, 000		1, 662, 420	220, 000	1, 311, 500	13, 532, 070
1923	1, 310, 000		2, 704, 000	1, 510, 000	716, 000	12, 055, 800
1924	2, 110, 000		2, 871, 900	12, 649, 100	448, 000	26, 485, 050
1925	507, 000		474, 000	1, 269, 000		10, 769, 400
1926	1, 060, 000		[13] 3, 375, 200	1, 590, 000		24, 278, 700
1927	250, 000		10, 000	298, 000		12, 701, 900
1928	1, 070, 000		843, 700	1, 995, 000		13, 803, 700
Total	14, 497, 793	20, 551, 838	24, 131, 138	86, 787, 775	236, 713, 874	177, 640, 550

[13] Includes 79,000 from Idaho.

Output of hatcheries owned by the State of Oregon

Year	Chinook fry	Silverside fry	Steelhead trout fry	Sockeye fry	Total
1877	50,000				50,000
1878	79,620				79,620
1879	1,876,500				1,876,500
1880	1,834,290				1,834,290
1881	2,554,290				2,554,290
1888	1,300,000				1,300,000
1889	4,500,000				4,500,000
1890	990,000				990,000
1891	[1] 792,000				792,000
1895	2,500,000				2,500,000
1896	2,500,000				2,500,000
1899	2,700,000				2,700,000
1900	2,500,000		200,000		2,700,000
1901	7,562,000		245,000		7,807,000
1902	11,220,550	7,957,000	256,327		19,433,877
1903	18,502,072	3,288,600	300,850		22,091,522
1904	[2] 48,730,791	3,974,185	143,849		52,848,825
1905	16,393,249	5,509,085	1,495,735		23,398,069
1906	[3] 27,404,596	7,503,655	1,859,696		36,767,947
1907	[4] 25,156,732	6,446,628	376,245		31,979,605
1908	[5] 21,209,394	5,359,709			26,569,103
1909	[6] 20,108,990	9,212,649	1,403,129		30,724,768
1910	[7] 24,169,365	3,631,827	2,364,120		30,165,312
1911	[8] 19,762,229	4,749,319	4,018,598	[9] 1,488,327	30,018,473
1912	[10] 18,077,971	9,580,497	1,358,742	[11] 1,957,825	30,975,035
1913	[11] 26,623,268	9,879,666	1,136,031	[12] 1,937,134	39,576,099
1914	[13] 21,945,746	5,893,965	758,233	[11] 1,978,140	30,576,084
1915	[14] 27,532,168	2,917,460	4,793,208		35,242,836
1916	[15] 27,120,254	[16] 4,215,705	3,180,709	[17] 2,399,000	[18] 36,915,668
1917	27,615,600	4,183,000	4,804,743	[11] 1,526,024	[18] 38,129,367
1918	28,109,125	4,556,207	1,633,580	[17] 2,731,823	[18] 37,030,735
1919	33,732,431	9,140,769	4,004,754	[19] 3,199,800	[18] 50,077,754
1920	26,033,409	2,775,785	5,240,190	600,000	34,649,384
1921	26,834,572	17,214,721	3,096,969	4,063,970	51,210,232
1922	16,811,710	12,297,662	7,828,851	467,000	37,405,223
1923	23,351,681	7,480,271	8,150,621	[20] 1,836,326	40,818,899
1924	45,272,574	12,766,536	[21] 11,273,124	5,327,310	74,639,724
1925	57,799,916	13,896,498	7,945,142	[22] 4,133,827	83,775,383
1926	63,889,286	22,755,821	11,836,722	[23] 5,942,000	104,423,829
1927	55,039,328	17,702,740	8,486,252	[24] 3,178,500	84,406,820
1928	48,610,426	13,099,329	6,785,219	[25] 5,732,500	74,227,854
Total	838,796,313	227,989,289	104,976,639	48,499,886	1,220,262,127

[1] Eggs from which hatched obtained from U. S. Bureau of Fisheries.
[2] 6,826,540 eggs obtained from U. S. Bureau of Fisheries.
[3] 7,714,000 eggs obtained from U. S. Bureau of Fisheries.
[4] 3,550,000 eggs obtained from U S. Bureau of Fisheries
[5] 3,020,000 eggs obtained from U. S. Bureau of Fisheries.
[6] 6,581,000 eggs obtained from U. S. Bureau of Fisheries.
[7] 6,465,300 eggs obtained from U. S. Bureau of Fisheries
[8] 3,950,000 eggs obtained from U. S. Bureau of Fisheries.
[9] 1,500,000 eggs obtained from U. S. Bureau of Fisheries.
[10] 8,000,000 eggs obtained from U. S Bureau of Fisheries
[11] 2,000,000 eggs obtained from U. S. Bureau of Fisheries.
[12] 2,491,000 eggs obtained from U. S. Bureau of Fisheries.
[13] 1,000,000 eggs obtained from U. S. Bureau of Fisheries.
[14] Eggs from which hatched obtained from U. S. Bureau of Fisheries
[15] All but 490,000 were fingerlings.
[16] All but 41,500 were fingerlings.
[17] 3,000,000 eggs obtained from U. S. Bureau of Fisheries.
[18] Most of the output comprised of fish 4 to 9 months old.
[19] 3,174,800 from eggs obtained from Alaska, and 25,000 from dwarf sockeye eggs obtained from Montana.
[20] Includes 884,335 pinks.
[21] Includes 646,700 pinks.
[22] Includes 2,503,100 pinks.
[23] Includes 277,500 pinks.
[24] Includes 754,600 pinks.
[25] Includes 1,837,995 pinks.

COLUMBIA RIVER AND TRIBUTARIES

The first fish-cultural work upon the Columbia River and in Oregon was at Clackamas, on the Clackamas River, a tributary of the Willamette River, which empties into the Columbia River about 180 miles from its mouth.

This hatchery was built in 1876 by the Oregon & Washington Fish Propagating Co., which operated it until 1880. In 1887 the State provided for and there was appointed a State fish commission. Almost the first work of the commission was to spend $12,000 appropriated by the legislature to put in repair and operate this hatchery. On July 1, 1888, it was informally turned over to the United States Commission of Fish and Fisheries, which paid over the purchase price, took formal possession in the following winter, and has operated it ever since, with the exception of several years when the building of dams stopped the progress of salmon to the hatchery. During this period a temporary station for the collection of eggs was established on Sandy River, about 15 miles away, and on Salmon River, a tributary of Sandy River, both tributaries of the Columbia River. Some eggs were also brought in from the California hatcheries and hatched at the Clackamas station. In 1901 the hatchery was moved about 4 miles down the river and has since been operated as both a rearing and a collecting station. In 1901 the State established another hatchery on the Clackamas River about 30 miles below the main station and between the north and south forks. In 1904 all were turned over to the United States. In 1915 the hatchery was moved again. In 1907 an experimental station for the collection of eggs of the early variety of chinook salmon was established by the State of Oregon on the Clackamas River below the Portland Railway, Light & Power Co.'s dam at Cazadero, but this was later operated by the United States Bureau of Fisheries. The building of a dam having cut off this station, another was established in 1913 at a point 30 miles distant from Portland.

In 1889 the State established a hatchery in the cannery of F. M. Warren, at Warrendale, in Multnomah County, on the Columbia River, which was operated in that year and in 1890.

In 1895 some of the Oregon salmon packers combined and organized the Columbia River Packers Propagating Co., which established a hatchery on the upper Clackamas River at the junction of the Warm Springs and the Clackamas and operated it in 1895 and 1896. The Government operated it in 1897 and 1898, after which it was turned over to the State and moved to the opposite side of the river.

In 1898 the collection of steelhead-trout eggs was first undertaken on the northwest coast by the State of Oregon on Salmon River, a tributary of the Columbia River, and met with fair success. In March, 1899, the Government sent a party to the falls of the Willamette River, near Oregon City, to collect steelhead eggs, and also operated for this purpose at its substation on the Salmon River, but the latter effort met with failure, as the rack was washed away. This station was turned over to the State on June 15, 1899.

In 1901 the State of Oregon did some experimental work at Swan Falls, on Snake River, the boundary for a considerable distance between Oregon and Idaho. During the winter and early spring of 1902 the State also worked Tucannon River, which is a tributary of

Snake River, for steelhead, but met with poor success. Snake River was worked again in 1902 at the foot of Morton Island, which is situated 2 miles above Ontario, in Malheur County. Title to the necessary property was secured from the War Department in 1903 and permanent buildings were erected. It was closed for some years and finally abandoned in 1911.

In 1901 the State of Oregon established an experimental hatchery in Wallowa County, on the Grande Ronde River, at the mouth of a small tributary called the Wenaha River, which enters the main stream about 50 miles from its mouth. A permanent station was established in the canyon about 1½ miles below the Wallowa bridge on the Wallowa River, a tributary of the Grande Ronde River, in 1903. This was transferred to Enterprise in 1921.

In 1902 the State of Oregon erected a permanent plant on Salmon River at its junction with Boulder Creek. This plant was closed in 1911.

In the same year the State established an experimental station on the McKenzie River, a tributary of the Willamette River, about one-half mile above Vida post office. This experimental work was resumed in 1905 at a point 2 miles below Gate Creek. The hatchery was permanently established at a spot about 30 miles from Eugene and near the town of Leaburg a year or two later. The plant has since been enlarged by the construction of rearing ponds.

In 1903 a hatchery was built by the State of Oregon on the Snake River near the town of Ontario, in eastern Oregon.

In 1906 an experimental station was established by the State on Breitenbush Creek, a short distance above its junction with the Santiam River, a tributary of the Willamette River, but the plant was destroyed, very shortly after its establishment, by a forest fire. An experimental station was reestablished here in 1909, but a heavy freshet raised the river so high that the penned fish escaped around the rack.

In 1909 the State of Oregon built at Bonneville, on Tanner Creek, a tributary of the Columbia River, a large central hatchery capable of handling 60,000,000 eggs, it being the intention of the State to hatch at this plant the eggs collected at other stations.

In the same year a temporary hatchery was located on the Santiam River by the State of Oregon, and an additional plant was placed at South Santiam in 1923.

During 1910 the State of Oregon received 1,500,000 red salmon eggs from the Yes Bay (Alaska) hatchery of the United States Bureau of Fisheries, and in a number of succeeding years they have received a consignment from the same source, as will be noted in the statistical tables. These were hatched out in the Bonneville hatchery and planted in the Columbia River.

The State of Oregon built a hatchery on the Klaskanine River, a tributary of Youngs River, near Olney, in Clatsop County, in 1911. In the same year an eyeing station for spring chinooks was opened by the State on the Willamette River, near Lowell.

Additional construction consisted of an egg-collecting station located on the Willamette at Reserve, and a hatchery at Oakridge, both created in 1914. Hatcheries located at Ontario and on the Salmon River in 1903 were abandoned in 1909 and 1910.

The first entrance of Washington (then a Territory) into fish-cultural operations was in 1879, when the State fish commissioner paid the Oregon & Washington Fish Propagating Co., which was operating the hatchery on the Clackamas River, $2,000 for salmon fry deposited in that river. In 1893 the State legislature established a hatchery fund which was to be supplied by licenses from certain lines of the fishery business. In 1895 its first hatchery in the Columbia River Basin was built on the Kalama River, about 4 miles distant from its junction with the Columbia, and in Cowlitz County. Shortly after this hatchery was built it was discovered that it was above where the salmon spawned, and a second hatchery was built 1¼ miles below the first named, as the rugged mountainous character of the country made transportation between the two sites difficult. The plant was rebuilt and enlarged in 1928, and 20 rearing ponds were built.

Another station for the collection and eyeing of eggs was established on the Chinook River, a small stream which empties into Baker Bay near the mouth of the Columbia.

During the fiscal year 1897 the United States Fish Commission established a station on Little White Salmon River, a stream which empties into the Columbia, on the Washington side, about 14 miles above the Cascades. During the fiscal year 1901 an auxiliary station was operated on Big White Salmon River, while fishing was carried on in Eagle and Tanner Creeks, in Oregon, the eggs obtained from these creeks being brought to the Little White Salmon hatchery.

In 1899 the State of Washington built and operated hatcheries on the Wenatchee River, a tributary of the Columbia River, about 1½ miles from Chiwaukum Station on the Great Northern Railway, and on Wind River, a tributary of the Columbia, about 1 mile from the junction. The latter was abandoned in 1922 and rebuilt in 1928.

In 1900 Washington State hatcheries were established in the Columbia River Basin as follows: White River hatchery, which was built on Coos Creek, which empties into a tributary of the White River, the location being about 2½ miles from where the Green River joins the White River; Methow River hatchery, built on the Methow River at the point where it is joined by the Twisp, about 22 miles from the Columbia River; Colville River hatchery, built on the north bank of Colville River, about 1½ miles from its mouth, and about 1 mile from Kettle Falls; Klickitat River hatchery, located on the east bank of the Klickitat River, about 6 miles from its mouth; and one on the Little Spokane River, about 10 miles from its mouth and about 9 miles north of the city of Spokane. The Klickitat River hatchery never was operated, while most of the others were operated intermittently.

In 1906 a hatchery was extablished by the State of Washington on the Lewis River, some distance above the town of Woodland. In 1919 this hatchery was operated by the United States Bureau of Fisheries. This has since been abandoned.

In 1909 the State of Washington established a hatchery near Pateros, on the Methow River, a tributary of the Columbia River, and on the Tilton.

In 1915 Clarke County, Wash., built a hatchery on the east side of Cold Creek, about 2 miles from the town of Vancouver.

A temporary station was established by the State of Washington on Wenatchee Lake, near Leavenworth, in 1915.

The Cowlitz hatchery was rebuilt on a new site near Lewis, Wash., in 1926. A small plant was located at Tilton, Wash., and abandoned in 1922.

The following table shows the plants of salmon and steelhead trout in the Columbia River and its tributaries by the Bureau of Fisheries and the States of Oregon and Washington:

Plants of salmon in the Columbia River and tributaries since 1877

Year ending June 30—	Sockeye		Chinook		Silverside	
	Fry	Yearlings, fingerlings, and adults	Fry	Yearlings, fingerlings, and adults	Fry	Yearlings, fingerlings, and adults
1877			300,000			
1878			79,620			
1879			3,076,500			
1880			1,834,290			
1881			2,554,290			
1888			1,300,000			
1889			4,500,000			
1890			3,756,475			
1891			5,694,000			
1892			1,332,400			
1893			4,100,000			
1894			213,000			
1895			[1] 2,523,000			
1896			9,832,150	557,150		
1897			10,641,394			
1898			26,212,074			
1899			19,979,241			
1900			22,510,869		7,175,824	
1901			24,977,310	1,668	5,559,750	
1902			44,328,085		17,545,724	
1903			40,174,313		8,721,720	
1904			71,694,587		8,422,085	
1905			17,107,217		1,354,610	
1906			[2] 36,324,805	47,980	828,472	300
1907			23,171,235		2,657,349	
1908			32,856,262	1,995,746	1,705,543	
1909			33,081,994	16,949	2,439,415	
1910			37,743,777	225	3,374,733	
1911	1,488,327		28,791,095	11,700	[3] 1,308,900	
1912	1,957,825		49,335,065	1,405,860	1,243,660	
1913	1,937,134		70,211,177		4,591,500	
1914	1,978,140		[4] 81,995,039	1,732,805	636,900	
1915			81,504,641	812,801	608,747	
1916	4,478,362	1,526,024	85,657,635	8,686,789	873,882	
1917	1,526,024		47,187,410	9,922,869	1,381,915	86,100
1918	2,731,823		64,929,898	10,383,400	3,763,832	18,800
1919	3,199,800	939,960	22,571,500	46,382,420	4,205,864	2,200
1920		676,615	48,115,679	28,042,600	4,803,585	22,050
1921		4,093,970	21,614,552	22,487,500	6,869,085	
1922		493,365	26,765,875	50,831,300	6,320,625	
1923		1,886,726	33,703,765	23,870,200	2,979,323	338,800
1924		5,327,310	46,301,753	32,278,300	4,902,150	121,850
1925		4,280,527	55,703,215	10,344,200	9,918,489	586,000
1926		5,963,500	52,677,283	42,613,000	7,210,189	
1927		3,178,500	60,551,361	18,532,000	2,888,972	
1928		5,759,380	56,544,029	29,011,500	10,909,450	
Total	19,297,435	34,125,877	1,416,059,860	339,968,962	135,202,293	1,176,100

[1] Includes 23,000 eggs. [2] Includes 48,200 eggs. [3] Includes 100,000 eggs. [4] Includes 1,000,000 eggs.

Plants of salmon in the Columbia River and tributaries since 1877—Continued

Year ending June 30—	Steelhead trout		Chum		Total	
	Fry	Yearlings, fingerlings, and adults	Fry	Yearlings, fingerlings, and adults	Fry	Yearlings, fingerlings, and adults
1877					300,000	
1878					79,620	
1879					3,076,500	
1880					1,834,290	
1881					2,554,290	
1888					1,300,000	
1889					4,500,000	
1890					3,756,475	
1891					5,694,000	
1892					1,332,400	
1893					4,100,000	
1894					213,000	
1895					2,523,000	
1896					9,832,150	557,150
1897					10,641,394	
1898					26,212,074	
1899	8,625				19,987,866	
1900	299,000				29,985,693	
1901	245,000				30,782,060	1,668
1902	256,327				62,130,136	
1903	563,550	37,033			49,459,583	37,033
1904	158,981				80,275,653	
1905	[5] 768,235				19,230,062	
1906	[6] 1,745,111	24,383			38,898,388	72,663
1907	26,640				25,855,224	
1908	15,000				34,576,805	1,995,746
1909	[5] 1,058,657				36,580,066	16,949
1910	[7] 2,063,688				43,182,198	225
1911	1,982,331		420,730		33,991,383	11,700
1912	1,387,500	116,300	106,020		54,030,070	1,522,160
1913	40,000		105,800		76,885,611	
1914	[8] 932,700		591,638		86,134,417	1,732,805
1915	4,128,833		8,299,572		94,541,793	812,801
1916	1,459,067	6,000	16,448,199		108,917,145	10,218,813
1917	4,074,330	338,850	5,332,125	248,050	59,501,804	10,595,869
1918	4,274,330		8,881,640		84,581,523	10,402,200
1919	4,663,820	135,500	210,600	460,800	34,851,584	47,920,880
1920	9,323,400	160,600	2,376,000	249,150	64,618,664	29,151,015
1921	3,027,260		2,140,180	5,067,900	33,651,077	31,649,370
1922	1,759,355		484,955		35,330,810	51,324,665
1923	3,457,139	723,000		257,500	40,140,227	27,076,226
1924	4,166,842	776,600	493,231	765,600	55,863,976	39,269,660
1925	3,007,324	474,000	480,000		69,109,028	15,684,727
1926	2,126,062	377,820	66,732		62,080,266	48,954,320
1927	2,398,362	10,000	591,400		66,430,095	21,720,500
1928	3,278,479	132,000	370,850		71,102,808	34,902,880
Total	62,695,948	3,312,086	47,399,672	7,049,000	1,680,655,208	385,632,025

[5] Includes 50,000 eggs. [6] Includes 58,000 eggs. [7] Includes 25,000 eggs. [8] Includes 79,000 eggs.

WASHINGTON

Willapa River.—In 1899 Washington established a hatchery on Trap Creek, a tributary of the Willapa River, situated about 200 yards from the creek's mouth. This was rebuilt and enlarged in 1928.

In 1916 local residents along the North River, a tributary of Willapa Harbor, contributed the funds to build a salmon hatchery, and this was constructed and put into operation the same year.

In 1917 a salmon hatchery was built and put into operation at Raymond. It is designated as Willapa Hatchery No. 2. The two latter were discontinued in 1922.

In 1918 some fishermen and public-spirited citizens of this section contributed the money for the building of a State hatchery on the Nasel River, a tributary of Willapa Harbor.

Chehalis River.—The construction of a hatchery on the Chehalis River, about 4 miles above the city of Montesano, was begun by the

State in October, 1897, but owing to bad weather and extreme high water was not completed until late in 1898. The hatchery was a failure until 1902 when a fair season was had, as was again true in 1903. It was not operated in 1904. Since the State began taking eggs from the Satsop River, a tributary of the Chehalis, it has been possible to fill the hatchery each season, and the project was enlarged in 1929.

In 1909 the site where eggs had been gathered on the Satsop River was purchased, and a new hatchery was erected there. It has three concrete rearing ponds and is fully equipped for the taking of spawn and the hatching out and caring for 5,000,000 fry. This plant was first operated in the fall of 1909.

Work was begun in September, 1914, by the United States Bureau of Fisheries on a hatching station on Lake Quinault, Wash., and a take of eggs was made the same year.

In lieu of installing fishways in their dams in the Humptulips River and tributaries, in the Grays Harbor section, two timber firms agreed to furnish the money needed to build a hatchery on Stevens Creek, west of Humptulips, and the same was constructed and put into operation in October of 1914. The plant is now the property of the State and was rebuilt in 1929.

In 1917 a hatchery was built by the State on Chehalis River near Dryad, with money contributed by two lumber companies in lieu of building fishway over a dam.

Puget Sound and tributaries.—In 1896 the State established a hatchery on Baker Lake, which is the head of Baker River, a tributary of the Skagit River, and this was the first establishment for the hatching of sockeye salmon. In July, 1899, it was sold to the United States Fish Commission. In 1901 steelhead trout eggs were collected on Phinney Creek, about 5 miles from the town of Birdsview, and some 30 miles from Baker Lake. In 1901 an auxiliary station was opened at Birdsview, on Skagit River, and steelhead trout eggs were collected on Phinney and Grandy Creeks and brought to Baker Lake to be hatched. The Birdsview station has since been developed as a main station, and the Baker Lake hatchery relegated to auxiliary status.

In 1898 a private hatchery (the necessary money being raised by subscription among the residents of Fairhaven, now Bellingham, and vicinity) was built near Lake Samish, a few miles from Fairhaven.

In 1899 a hatchery was built by the State on Kendall Creek, a tributary of the Nooksack River, about 300 yards from same, and about 2 miles from the railway station of Kendall. Except in 1903, this hatchery has since been operated continuously. An eyeing station was built in 1907 on the south fork of the Nooksack River, about 1 mile from Acme.

In the same year the State built a hatchery on the Skokomish River, about 4 miles from its mouth. An eyeing station was also erected on the north fork of the same river. The main station was not operated in 1904 and only on a small scale in 1903 and 1905.

The State, in 1889, built a hatchery on Friday Creek, a tributary of the Samish River, situated about 1 mile from the mouth of the creek.

The following State hatcheries were first operated in 1900: Snohomish hatchery, built on the west bank of Skykomish River, a few miles from its mouth; Nisqually River hatchery, built on Muck Creek, about one-half mile from the Nisqually River, and about 4 miles from the town of Roy, in Pierce County; and the Stillaguamish hatchery, located on the Stillaguamish River, about 4 miles from the town of Arlington, in Snohomish County. The latter has since been moved to Jim Creek, a tributary of the south branch of the Stillaguamish River.

The Startup hatchery, located near Startup, on the Skykomish River, was formerly used as a collecting station for the Snohomish hatchery. It is still used for this purpose, but also retains and hatches a considerable quantity of spawn. The station is about 4 miles from the Snohomish hatchery. In 1918 it was rebuilt and now bears the name of Skykomish hatchery.

In 1900 the State established a fisheries experimental station at Keyport Landing, on the east arm of Port Orchard Bay, with Pearson as the nearest post office. The work of the station was devoted to salmon and oysters until it was abandoned a few years later.

The State established a hatchery on the Dungeness River, about 7 miles from the town of Dungeness, in Clallam County, in 1901. In 1906 it constructed a hatchery on a small tributary of the Skagit River, between Hamilton and Lyman. This was destroyed in 1917 by floods. The station built on Sauk River, a tributary of the Skagit, has been operated only occasionally since the Skagit hatchery was built.

The White River hatchery was constructed on Suice Creek, a tributary of Green River, some years ago. During the summer of 1909 a new hatchery was built at this station, the old one being too small to accommodate the amount of spawn that could be taken. The new hatchery is located on the east side of Suice Creek near the county road. The building contains 140 hatching troughs. The plant has a pond system, where the fry are kept and fed until they are able to shift for themselves.

During the summer of 1911 the city of Tacoma constructed a large concrete dam in the Green River, about 4 miles west of Eagle Gorge. As this dam prevented the salmon from reaching the spawning beds, the State established an eyeing station the same year just below the dam. In 1913 the name was changed to Green River hatchery, to conform to the name of the main stream. All work in this field has been concentrated in a large new establishment completed in 1927.

In 1912 the United States Bureau of Fisheries completed the Quilcene and Duckabush hatcheries. Both are on small tributaries entering the west side of Hoods Canal, an arm of Puget Sound.

In 1913 a new station was operated by the Bureau on the Dusewallips River, a tributary of Hoods Canal, Puget Sound, near Brinnon. Two new field stations—on Elwell River, a tributary of the Skykomish River, near Sultan, and on Sauk River, a tributary of the Skagit River, near Darrington—were also put into operation the same year. The Sauk River had been worked by the State at one time.

In 1913 the Middle Fork Nooksak eyeing station was transformed into a hatchery. In the same year the eyeing station on the south fork was moved farther up the river. The plant was finally abandoned in 1922.

In 1914 stations were established by the United States Bureau of Fisheries on Day Creek and Illabot Creek, tributaries of the Skagit River, while a substation was opened on Hamahama River at Eldon, distant about 9 miles up Hood Canal from the mouth of the Duckabush River.

On May 23, 1914, the Baker Lake hatchery building was destroyed by fire. In addition to the building and equipment, 1,305,820 silver fry and 823,097 sockeye fry were destroyed. The station was rebuilt but was burned down again in 1919. It has since been rebuilt.

In 1915 the State built a hatchery on the Pilchuck River, a tributary of the Skykomish River, near Granite Falls.

In lieu of building a fishway in its dam on the Elwha River, near Port Angeles, the Olympic Power Co. furnished the funds needed to build a hatchery below the dam, and this was opened by the State in 1915. It was discontinued in 1922.

In 1916 the city of Tacoma furnished funds to build a hatchery in lieu of a fish ladder over the Nisqually power plant dam, and the hatchery was constructed by the State at Chambers Prairie and opened in 1916. It is known as the Chambers Creek hatchery.

In 1917 a new hatchery was established by the State at Orting, on the Puyallup River, while in 1918 an eyeing station was established at Tahuya, on Hoods Canal, near the Skokomish hatchery.

In 1919 the Nisqually hatchery was destroyed by floods.

The following tables show the total output of the salmon hatcheries in the State of Washington owned by the United States Bureau of Fisheries and the hatcheries owned by the State itself:

Output of the salmon hatcheries in Washington owned by the United States Bureau of Fisheries

Year ending June 30—	Chinook			Sockeye, or blueback			Silver, or coho		
	Eggs	Fry	Fingerlings, yearlings, and adults	Eggs	Fry	Fingerlings, yearlings, and adults	Eggs	Fry	Fingerlings, yearlings, and adults
1897		1, 848, 760							
1898		7, 391, 886							
1899	4, 926, 000	1, 791, 056							
1900	2, 686, 000	6, 626, 947			10, 683, 000				
1901	6, 581, 000	5. 427, 680			3, 834, 453			174, 041	
1902		15, 637, 687			3, 371, 000				
1903		16, 774, 030			3, 731, 789			81, 812	
1904	7, 506, 000	17, 386, 183			3, 855, 000			3, 984, 645	
1905		4, 236, 276			7, 819, 281	10, 000	107, 000	8, 071, 081	
1906	7, 714, 000	14, 846, 905		880, 000	3, 285, 130	9, 500	239, 180	6, 445, 574	
1907	3, 550, 000	6, 512, 738			4, 224, 255		760, 000	3, 636, 952	
1908	1, 485, 000	12, 372, 503	1, 537, 941	75, 000	8, 514, 305		296, 000	13, 262, 714	
1909	3, 650, 000	11, 565, 553	14, 186	100, 000	5, 430, 626		272, 000	7, 661, 110	
1910	3, 813, 250	9, 175, 610			4, 554, 825		275, 000	10, 888, 025	
1911	3, 350, 000	7, 307. 455	11, 700		5, 496, 000		102, 000	4, 550, 615	
1912	8. 020, 000	10, 959, 728	655, 095		4, 692, 573		52, 000	10, 599, 939	
1913	19, 713, 000	19, 933, 300			5, 751, 700		102, 000	10, 754, 617	
1914	4, 584, 000	31, 140, 440	1, 130, 505	50, 000	2, 583, 469	120, 000		13, 591, 354	
1915	4, 998, 000	38, 162, 139	987, 495	155, 000	10, 820, 441	46, 575	35, 000	20, 673, 056	41, 500
1916		38, 012, 864	7, 488, 270		15, 737, 420	2, 666, 308	2, 500	5, 466, 334	1, 460, 354
1917		14, 969, 904	5, 865, 226		11, 861, 825	2, 145, 953		3, 960, 000	4, 559, 860
1918	3, 150, 000	2, 185, 218	41, 202, 694		3, 625, 000	12, 705, 285		972, 300	10, 118, 815
1919	960, 000	389, 002	18, 474, 900		1, 000, 000	15, 799, 960		7, 544, 020	697, 380
1920	7, 002, 000		24, 456, 970		14, 726, 615	9, 876, 000		6, 887, 050	1, 820, 500
1921	3, 650, 000		23, 735, 465	[1] 50, 000	8, 000, 000	3, 457, 000		600, 000	6, 551, 200
1922	1, 400, 000		40, 356, 070		4, 200, 000	7, 701, 635		600, 000	10, 964, 940
1923	[2] 4, 000, 000		19, 852, 145		14, 200, 000	1, 998, 400	100, 000	8, 371, 025	3, 077, 055
1924	2, 246, 000	745, 000	21, 296, 105	[3] 3,320, 000	8, 519. 840	4, 528, 000		11, 419, 990	3, 892, 000
1925	7, 494, 880	380, 000	25, 346, 000	3, 150, 000	21, 770, 000	2, 845, 000	100, 000	10, 177, 650	1, 716, 639
1926	10, 656, 640		23, 859, 600	150, 000	9, 795, 800	6, 979, 180	201, 000	4, 555, 800	2, 470, 900
1927	9, 112, 000	266, 000	17, 607, 800	125, 000	12, 030, 000	2, 668, 170	100, 000	5, 142, 400	997, 600
1928	18, 079, 000	342, 500	28, 810, 220	4, 410, 000	13, 337, 000	2, 613, 600	100, 000	10, 852, 700	704, 000
Total	150, 326, 770	296, 387, 364	302, 688, 337	12, 465, 000	227, 451, 347	76, 170, 566	2, 843, 680	190, 924, 804	49, 072, 743

[1] 30,000 from Birdsview to Clackamas, Oreg., and 20,000 from Birdsview to Craig Brook, Me.

[2] 225,000 from Little White Salmon to central station, Washington, D. C., and 1,750,000 from same station to Clackamas, Oreg.

[3] 25,000 from Quinault, Wash., to Medford, Oreg.

Output of the salmon hatcheries in Washington owned by the United States Bureau of Fisheries—Continued

Year ending June 30—	Humpback			Steelhead trout		
	Eggs	Fry	Fingerlings, yearlings, and adults	Eggs	Fry	Fingerlings, yearlings, and adults
1900					26,000	
1902					110,000	
1903				80,000	440,000	223,815
1904		176,597		255,000	70,000	
1905				414,400	3,205	
1906	2,000	969,990		348,000	540,000	
1907				200,000	941,505	
1908	502,000	6,764,762		224,000	136,916	
1909				220,000	717,691	
1910		1,368,000		300,000	1,437,038	
1911		96,000		660,000	911,650	
1912		2,566,325		905,000	2,284,315	
1913		1,880		1,330,000	1,477,150	
1914	13,260,000	21,114,023	4,355	729,000	1,792,430	
1915		6,929,500		125,000	2,008,698	137,665
1916	7,000,000	6,106,400	2,915,000	1,040,000	341,600	891,000
1917		165,000	7,449,030	550,000	1,979,010	1,424,000
1918		2,132,831	3,736,000	320,000	103,000	3,482,620
1919		2,354,500	369,958	250,000		305,000
1920		64,700		241,600	138,200	470,400
1921				[4] 493,000	15,000	2,469,550
1922			909,400	[5] 300,000		365,800
1923	50,000		1,672,435	[6] 434,000	260,000	1,256,105
1924		918,000		[7] 70,000	368,685	1,898,560
1925		10,892,500		100,000	50,000	709,275
1926		844,600		68,000	120,000	906,820
1927		3,544,000		200,000		819,700
1928		2,387,000		290,000	1,182,500	1,308,000
Total	20,814,000	69,396,608	17,056,178	10,147,000	17,454,593	16,668,310

Year ending June 30—	Chum		Total		
	Fry	Fingerlings, yearlings, and adults	Eggs	Fry	Fingerlings, yearlings, and adults
1897				1,848,760	
1898				7,391,886	
1899			4,926,000	1,791,056	
1900			2,686,000	17,335,947	
1901			6,581,000	9,436,174	
1902				19,118,687	
1903			80,000	21,027,631	223,815
1904			7,761,000	25,472,425	
1905			521,400	20,129,843	10,000
1906			9,183,180	26,087,599	9,500
1907			4,510,000	15,315,450	
1908			2,582,000	41,051,200	1,537,941
1909			4,242,000	25,374,980	14,186
1910			4,388,250	27,423,498	
1911	69,000		4,112,000	18,430,720	11,700
1912	2,495,000		8,977,000	33,597,880	655,095
1913	19,479,000		21,145,000	57,397,647	
1914	8,672,735		18,623,000	78,894,451	1,254,860
1915	35,504,707		5,313,000	114,098,541	1,213,235
1916	21,500,944	1,000,000	8,042,500	87,165,562	16,420,932
1917	14,403,300	7,014,580	550,000	47,339,039	28,458,649
1918	9,892,145		3,470,000	18,910,494	71,245,414
1919	4,544,000	4,524,560	1,210,000	15,831,522	40,171,758
1920	7,318,100	5,667,150	7,243,600	29,134,665	42,291,020
1921	7,000,000	19,436,400	4,193,000	15,615,000	55,649,615
1922	1,540,000	14,027,610	1,700,000	6,340,000	74,325,405
1923	[8] 8,324,830	14,902,900	4,634,000	31,105,855	42,759,040
1924	23,512,320	758,000	5,636,000	45,483,835	32,372,665
1925	16,051,650		10,844,880	59,321,800	30,616,914
1926	18,163,400		11,075,640	33,479,600	34,216,500
1927	17,966,000		9,537,000	38,948,400	22,093,270
1928	[9] 23,669,000		25,879,000	48,770,700	33,435,820
Total	240,106,131	67,331,200	199,646,450	1,038,670,847	528,987,334

[4] 118,500 were transferred from Birdsview to eastern hatcheries where they were hatched and planted in near-by waters.
[5] 25,000 from Birdsview to Manchester, Iowa; 25,000 to Woods Hole, Mass.; 20,000 from Quilcene to Charlevoix, Mich.
[6] 185,000 from Washougal River to Bozeman, Mont., Clackamas, Oreg., St. Johnsbury, Vt., and Spearfish, S. Dak.
[7] 25,000 from Birdsview, Wash., to Leadville, Colo.
[8] Includes 50,000 eggs sent from Birdsview, Wash., to central station, Washington, D. C.
[9] Includes 3,000,000 eggs.

Output of the salmon hatcheries owned by the State of Washington [1]

Year ending June 30—	Chinook fry	Chum fry	Humpback fry	Silver, or coho, fry	Sockeye, or blueback, fry	Steelhead-trout fry	Total
1896	4, 500, 000						4, 500, 000
1897	4, 050, 000				5, 500, 000		9, 550, 000
1898	4, 275, 000				5, 400, 000		9, 675, 000
1899	8, 595, 000			189, 000			8, 784, 000
1900	12, 251, 600	10, 301, 760		13, 778, 280		1, 736, 560	38, 068, 200
1901	12, 275, 400	16, 478, 280		19, 747, 894		1, 398, 476	49, 900, 050
1902	14, 766, 822	9, 937, 390		32, 964, 593		2, 481, 371	60, 150, 176
1903	14, 283, 499	9, 937, 390		28, 659, 079		3, 134, 076	56, 014, 044
1904	13, 261, 184		295, 200	15, 725, 196		3, 868, 866	33, 150, 446
1905	7, 101, 180			12, 226, 294		2, 433, 635	21, 761, 109
1906	10, 943, 550	3, 268, 800		28, 906, 380		2, 769, 784	45, 888, 514
1907	8, 897, 670	6, 120, 000		28, 668, 600		3, 575, 943	47, 262, 213
1908	18, 647, 600	4, 342, 350	2, 655, 900	29, 273, 202		4, 578, 075	59, 497, 127
1909	17, 440, 950	8, 218, 000		24, 543, 200		4, 080, 450	54, 282, 600
1910	21, 168, 350	8, 607, 500	519, 600	30, 894, 100		4, 855, 000	66, 044, 550
1911	16, 458, 502	13, 326, 750		33, 097, 750		5, 163, 180	68, 046, 182
1912	23, 380, 516	4, 684, 950	370, 785	37, 164, 125		4, 832, 067	70, 432, 443
1913	30, 542, 928	14, 711, 400		50, 263, 290		9, 089, 250	104, 606, 868
1914	35, 529, 709	7, 842, 266	1, 532, 737	33, 494, 380	49, 792	3, 601, 514	82, 050, 398
1915 [2]	[3] 39, 784, 092	27, 458, 665	578, 504	60, 169, 474	62, 631	3, 457, 130	131, 510, 496
1916 [4]	48, 239, 092	41, 890, 354	5, 902, 227	38, 877, 396	607, 979	9, 984, 852	145, 501, 900
1917 [5]	34, 228, 979	15, 086, 648		5, 842, 775	808, 455		55, 966, 857
1918 [6]	83, 175, 074	71, 750, 001	6, 086, 256	45, 660, 603	[7] 6, 571, 770	10, 250, 532	223, 494, 236
1919 [6]	45, 773, 506	22, 228, 025		16, 220, 087	645, 520	7, 993, 452	92, 860, 590
1920	[8] 32, 984, 300	22, 602, 325	1, 315, 500	28, 601, 000		12, 011, 480	97, 514, 605
1921	8, 297, 607	[9] 114, 144, 057	718, 600	[10] 41, 330, 887		[11] 8, 300, 217	172, 791, 368
1922	40, 957, 290	24, 671, 252	3, 475, 300	43, 884, 473		5, 408, 158	118, 396, 473
1923	30, 322, 357	2, 359, 150	[12] 14,417,127	46, 643, 976	284, 800	7, 397, 664	101, 425, 074
1924	29, 046, 267	9, 655, 351	6, 880, 944	76, 305, 136		7, 899, 562	129, 787, 260
1925	24, 750, 314	10, 939, 574	[13] 29,588,675	69, 473, 210		7, 753, 145	142, 504, 918
1926	28, 929, 007	17, 867, 454	4, 608, 715	74, 219, 998	5, 700	3, 824, 539	129, 455, 413
1927	48, 948, 584	9, 993, 405	1, 300, 000	55, 579, 622		5, 509, 050	121, 130, 661
1928	[14] 40, 246, 487	16, 520, 232	[15] 6, 834, 650	[16] 66, 520, 232	49, 400	8, 573, 175	138, 744, 176
Total	813, 852. 416	524, 943, 329	87, 080, 720	1, 088, 924, 232	19, 986, 047	155, 961, 203	2, 690, 747, 947

[1] As the printed reports of the State before 1913 in many instances report as the output the number of eggs gathered, it has been necessary in such cases to make an arbitrary reduction from these figures, in order to allow for the loss in the egg stage. In addition to figures in table, in 1916, 13,424,362; in 1918, 6,745,823; and in 1919, 12,351,780 dwarf sockeyes were hatched and planted in waters of the State.
[2] A considerable proportion of the fry was fed in rearing ponds for some time before planting.
[3] 29,900 eggs were distributed in addition.
[4] Year ends Nov. 30, 1916.
[5] Period from Nov. 30, 1916, to Mar. 31, 1917.
[6] Year ending Mar. 31.
[7] In addition 6,000,000 eggs were furnished by the U. S. Bureau of Fisheries.
[8] 550,000 were eggs shipped to eastern States and 16,000 were eggs furnished University of Washington.
[9] Includes 10,000 eggs furnished to University of Washington.
[10] Includes 22,000 eggs furnished to University of Washington and 100,000 eggs sold to State of Connecticut.
[11] Includes 50,000 eggs sold to State of Connecticut and 470,000 eggs sold to private hatcheries in Washington.
[12] Hatched from eggs received from U. S. Bureau of Fisheries of Alaska.
[13] Eggs gathered in Alaska waters.
[14] 1,990,000 eggs were furnished to Alaska Territorial Fish Commission.
[15] 1,000,000 eggs furnished U. S. Bureau of Fisheries, Quilcene, Washington.
[16] 200,000 eggs furnished Lincoln Park, Chicago.

The table following shows the plantings made in waters of Washington other than the Columbia River by the United States Bureau of Fisheries and the State of Washington.

Plants of salmon in the waters of Washington other than the Columbia River

Year ending June 30—	Puget Sound and tributaries					
	Chinook		Sockeye		Silver, or coho	
	Fry	Yearlings, fingerlings, or adults	Fry	Yearlings, fingerlings, or adults	Fry	Yearlings, fingerlings, or adults
1897			5, 500, 000			
1898			5, 400, 000			
1899	7, 470, 000				189, 000	
1900			10, 683, 000		6, 749, 280	
1901	300, 000		3, 834, 453		14, 360, 185	
1902	2, 141, 322		3, 371, 000		23, 161, 069	
1903	2, 113, 850		3, 731, 789		21, 507, 771	
1904	1, 865, 933		3, 855, 000		14, 071, 845	
1905	2, 590, 738				16, 441, 375	
1906	4, 819, 290		3, 573, 130	9, 500	29, 755, 574	14, 840
1907	3, 907, 598				26, 960, 552	
1908	8, 356, 709		8, 514, 305		37, 613, 466	
1909	9, 647, 288		5, 430, 626		28, 622, 310	
1910	11, 681, 060		4, 554, 825		36, 837, 125	
1911	4, 984, 482		5, 496, 000		29, 941, 865	
1912	4, 646, 254		4, 692, 573		39, 788, 614	
1913	7, 561, 328		5, 751, 700		56, 128, 207	
1914	7, 392, 826		[1] 2, 683, 261	[2] 120, 000	42, 213, 911	
1915	15, 222, 734		7, 371, 056		74, 505, 147	
1916	22, 022, 439	802, 795	1, 897, 420	520	42, 696, 932	1, 455, 490
1917	26, 890, 383	750, 612	1, 520, 280	2, 093, 000	6, 227, 775	4, 560, 460
1918	35, 318, 366	411, 060	7, 696, 750	9, 319, 275	29, 249, 710	6, 845, 115
1919	22, 244, 102	195, 900	645, 520	8, 622, 000	12, 285, 222	2, 864, 980
1920	2, 726, 414	175, 900	10, 250, 000	980, 000	26, 007, 664	2, 671, 000
1921	15, 343, 540	1, 277, 165	7, 050, 000	9, 000	26, 456, 155	4, 671, 100
1922	8, 675, 578	669, 020	4, 234, 800	4, 380, 000	17, 776, 266	10, 016, 940
1923	6, 646, 267	300, 445	14, 200, 000	1, 004, 000	61, 297, 693	3, 068, 055
1924	5, 708, 470	1, 415, 105	2, 840		60, 279, 113	3, 892, 000
1925	8, 992, 786	1, 160, 000	5, 700		53, 832, 128	1, 716, 639
1926	15, 106, 794	1, 513, 300	5, 275, 000	214, 360	37, 420, 067	1, 960, 900
1927	13, 959, 402	1, 947, 800			38, 608, 757	614, 100
Total	278, 335, 953	10, 619, 102	137, 221, 028	26, 751, 655	910, 984, 778	44, 351, 619

Year ending June 30—	Puget Sound and tributaries					
	Humpback		Chum		Steelhead	
	Fry	Yearlings, fingerlings, or adults	Fry	Yearlings, fingerlings, or adults	Fry	Yearlings, fingerlings, or adults
1900			10, 301, 760		1, 572, 560	
1901			16, 478, 280		1, 398, 476	
1902			9, 937, 390		2, 591, 371	
1903			9, 937, 390		3, 107, 891	218, 200
1904	471, 797				3, 518, 476	
1905					[3] 1, 329, 940	
1906	969, 990		1, 800, 000		3, 162, 174	15, 000
1907	4, 224, 255		5, 220, 000		3, 964, 308	
1908	9, 420, 662		2, 278, 350		4, 566, 491	
1909			6, 048, 000		[4] 4, 499, 141	
1910	1, 887, 600		7, 748, 500		6, 292, 338	
1911	96, 000		12, 074, 060		4, 841, 330	
1912	5, 432, 110		3, 526, 170		[5] 6, 732, 805	1, 000
1913	1, 888		31, 408, 960		9, 731, 400	
1914	22, 647, 060	[2] 4, 355	15, 535, 046		4, 444, 271	
1915	7, 508, 004		51, 852, 050		4, 925, 555	
1916	12, 005, 627	2, 918, 000	41, 541, 949	1, 000, 000	5, 102, 566	891, 000
1917	165, 000	7, 449, 030	12, 955, 800	6, 766, 530	1, 979, 010	1, 420, 500
1918	8, 219, 086	4, 736, 000	52, 674, 752		4, 851, 092	3, 520, 420
1919	2, 354, 000	369, 958	21, 480, 325	4, 063, 760	3, 152, 452	
1920	64, 700		7, 311, 100	5, 484, 000	[6] 3, 275, 000	393, 400
1921	3, 490, 300		37, 672, 212	7, 793, 000	2, 752, 113	1, 603, 300
1922	16, 425, 627	798, 400	3, 899, 150	14, 027, 610	4, 130, 794	365, 800
1923	6, 880, 994	1, 672, 435	11, 835, 480	14, 645, 400	3, 639, 674	1, 178, 105
1924	30, 506, 675		30, 331, 894		4, 638, 230	1, 638, 560
1925	14, 367, 215		8, 027, 263		1, 986, 370	708, 875
1926	2, 144, 600		18, 233, 400		3, 882, 565	312, 700
1927	12, 077, 495		32, 225, 751		6, 631, 975	819, 700
Total	161, 360, 685	17, 948, 178	462, 335, 032	53, 780, 300	112, 700, 368	13, 086, 560

[1] Includes 50,000 eggs.
[2] All fingerlings.
[3] Includes 14,400 eggs.
[4] Includes 100,000 eggs.
[5] Includes 25,000 eggs.
[6] Includes 125,000 eggs.

Plants of salmon in the waters of Washington other than the Columbia River—Con.

Year ending June 30—	Quinault Lake and River							
	Chinook		Sockeye		Silverside		Steelhead	
	Fry	Yearlings, fingerlings, or adults	Fry	Yearlings, fingerlings, or adults	Fry	Yearlings, fingerlings, or adults	Fry	Finger-lings
1915	19, 913		3, 558, 591		198, 966		10, 598	
1916	29, 600	4, 810	13, 840, 000	2, 665, 788	96, 650	4, 864		
1917	160, 000		11, 150, 000	52, 953	1, 910, 000			
1918	220, 000		2, 500, 000	3, 386, 010	200, 000	3, 303, 700		
1919	100, 000	109, 400	1, 000, 000	4, 738, 000	600, 000	419, 400		
1920		34, 600	4, 400, 000	8, 896, 000	500, 000	178, 000		
1921		24, 800	950, 000	3, 448, 000		1, 398, 000		
1922		47, 000	250, 000	3, 295, 000	600, 000	948, 000		
1923				944, 000		78, 000		
1924			1, 000, 000	3, 890, 000			70, 000	260, 000
1925			1, 000, 000	2, 845, 000	874, 000			
1926		13, 300	4, 520, 000	6, 765, 000		263, 500		105, 000
1927			5, 300, 000	1, 672, 470	285, 400			
Total	529, 513	233, 910	49, 468, 591	42, 598, 221	5, 265, 016	6, 593, 464	80, 598	365, 000

Year ending June 30—	Chehalis River fry				Willapa River fry			
	Chinook	Silver, or coho	Chum	Steel-head	Chinook	Silver, or coho	Chum	Steel-head
1899	1, 215, 000							
1900	2, 355, 300				881, 000			190, 000
1901	1, 909, 800				653, 400			
1903					2, 163, 019	1, 800, 000		500, 000
1904	900, 000				819, 504	204, 876		420, 390
1905					630, 000	1, 800, 000		288, 000
1906		2, 563, 380	1, 468, 800		529, 650	2, 160, 000		171, 550
1907		2, 250, 000	900, 000		393, 660	2, 250, 000		526, 500
1908	163, 000	3, 275, 000	2, 064, 000		678, 600	654, 500		148, 500
1909	148, 000	1, 800, 000	1, 757, 000		322, 200	504, 000		399, 000
1910	403, 000	1, 577, 000	859, 000		455, 200	64, 000		
1911	111, 150	4, 041, 900	900, 960	937, 500	734, 350	2, 457, 900		300, 000
1912	118, 750	3, 575, 700	1, 052, 760	93, 752	748, 600	3, 111, 750		303, 825
1913	119, 700	1, 690, 200	3, 177, 680	412, 500	729, 600	1, 386, 000		382, 500
1914	139, 000	2, 977, 260	497, 300	701, 118	3, 247, 345	1, 785, 580		248, 555
1915	73, 337	4, 790, 474	1, 230, 000	551, 302	302, 461	581, 730	1, 581, 750	105, 440
1916	854, 170	6, 811, 315	4, 218, 930	638, 733	2, 570, 105	108, 550	1, 181, 720	
1917	495, 350	120, 000	2, 590, 000		2, 178, 185	595, 000		
1918	2, 978, 288	12, 275, 990	17, 725, 949	967, 975	5, 411, 725	1, 809, 901	2, 359, 805	771, 600
1919	279, 200	6, 017, 655	4, 763, 000	1, 847, 400	1, 460, 206	372, 500	318, 100	197, 060
1920	1, 928, 839	13, 134, 755	27, 694, 449	1, 182, 500	294, 604	4, 885, 268	5, 613, 783	1, 666, 500
1921	4, 376, 450	12, 706, 213		1, 296, 005	6, 023, 500	3, 208, 420	89, 585	1, 240, 900
1922	1, 599, 530	17, 218, 000		1, 499, 870	2, 536, 780	10, 865, 300		1, 909, 000
1923	826, 420	17, 218, 000	5, 601, 420	704, 372	5, 072, 605	4, 705, 340		979, 885
1924	313, 519	9, 720, 231	3, 640, 000	600, 640	3, 784, 325	3, 591, 000		631, 790
1925	172, 279	16, 023, 401	9, 773, 459	406, 300	6, 338, 790	8, 270, 645		1, 085, 342
1926	458, 700	19, 209, 590	1, 131, 000	726, 550	8, 989, 450	2, 820, 165	205, 265	530, 535
1927	314, 000	19, 501, 790	1, 340, 000	530, 950	5, 214, 695	7, 393, 235	167, 395	462, 550
Total	22, 252, 782	178, 497, 854	92, 385, 707	13, 097, 467	63, 163, 559	67, 385, 660	11, 517, 403	13, 459, 422

Plants of salmon in the waters of Washington other than the Columbia River—Con.

Year ending June 30—	Total by species						Grand total
	Chinook	Sockeye	Silver, or coho	Hump-back	Chum	Steelhead	
1878	[7] 3,000						3,000
1897		5,500,000					5,500,000
1898		5,400,000					5,400,000
1899	8,685,000		189,000				8,874,000
1900	3,236,300	10,683,000	6,749,280		10,301,760	1,762,560	32,732,900
1901	2,863,200	3,834,453	14,360,185		16,478,280	1,398,476	38,934,594
1902	2,141,322	3,371,000	23,161,069		9,937,390	2,591,371	41,202,152
1903	4,276,869	3,731,789	23,307,771		9,937,390	3,826,091	45,079,910
1904	3,585,437	3,855,000	14,276,721	471,797		3,938,866	26,127,821
1905	3,220,738		18,241,375			1,617,940	23,080,053
1906	5,348,940	3,582,630	34,493,794	969,990	3,268,800	3,348,724	51,012,878
1907	4,301,258		31,460,552	4,224,255	6,120,000	4,490,808	50,596,873
1908	9,198,309	8,514,305	41,542,966	9,420,662	4,342,350	4,714,991	77,733,583
1909	10,117,488	5,430,626	30,926,310		7,805,000	4,898,141	59,177,565
1910	12,539,260	4,554,825	38,478,125	1,887,600	8,607,500	6,292,338	72,359,648
1911	5,829,982	5,496,000	36,441,665	96,000	12,975,020	6,078,830	66,917,497
1912	5,513,604	4,692,573	46,476,064	5,432,110	4,578,930	7,131,382	73,824,663
1913	8,410,628	5,751,700	59,204,407	1,888	34,586,640	10,526,400	118,481,663
1914	10,779,171	2,803,261	46,976,751	22,651,415	16,032,346	5,393,944	104,636,888
1915	15,618,445	10,929,647	80,076,317	7,508,004	54,663,800	5,592,895	174,389,108
1916	26,283,919	18,403,728	51,173,801	14,923,627	47,942,599	6,632,299	165,359,973
1917	30,474,530	14,816,233	13,413,235	7,614,030	22,312,330	3,399,510	92,029,868
1918	44,339,439	22,902,035	53,684,416	12,955,086	72,760,506	10,111,087	216,752,569
1919	24,388,808	15,005,520	22,559,757	2,723,958	30,625,185	5,196,912	100,500,140
1920	5,160,357	24,526,000	47,376,687	64,700	46,103,332	6,517,400	129,748,476
1921	27,045,455	11,457,000	48,439,888	3,490,300	46,554,787	6,892,318	143,879,750
1922	13,527,908	12,159,800	57,424,506	17,224,027	17,926,760	7,905,464	126,168,465
1923	12,845,737	16,148,000	86,367,088	8,553,429	32,082,303	6,502,036	162,498,593
1924	11,221,419	4,892,840	77,482,344	30,506,675	33,971,894	7,839,220	165,914,392
1925	16,663,855	3,850,700	80,716,813	14,367,215	17,790,722	4,186,887	137,576,192
1926	26,082,544	16,774,360	61,673,722	2,144,600	19,569,665	5,961,800	132,206,691
1927	21,435,897	6,972,470	66,403,232	12,077,495	33,733,146	9,454,225	150,076,465
Total	375,138,819	256,039,495	1,213,077,841	179,308,863	621,008,435	154,202,915	2,798,776,270

[7] These were brought from the Clackamas (Oreg.) station and planted in some unnamed lake.

BRITISH COLUMBIA

Fraser River.—The first hatchery established by the Dominion of Canada on the Pacific coast was erected in 1884 at what is now Bon Accord, a point on the lower river some 4 miles above New Westminster, and on the opposite shore. The next built was in 1901 on Granite Creek, Shuswap Lake, which discharges into the Fraser through the South Thompson River, the lake being about 280 miles from New Westminster. In 1904 another hatchery was established on Harrison Lake on the Lillooet River, first large tributary of the Fraser on the north side; also one about 4 miles east of the lower extremities of Pemberton Meadows, at the junction of Owl Creek and the Birkenhead River, 4 miles above its confluence with the eastern branch of the Lillooet River, which in turn discharges into Lillooet Lake. In 1907 a hatchery was built on Stuart Lake, near the headwaters of the Fraser.

In 1914 the Bon Accord hatchery had to be abandoned, due to the laying out of a town site around it, and the equipment was transferred to Queen's Park, New Westminster.

The Province of British Columbia established the Seton Lake hatchery in 1903 on Lake Creek, on the north side, about half a mile from the outlet of Seton Lake; but it has not been operated since 1917.

Hatchery operations were commenced at Pitt Lake in 1916, when a small station was built to take care of 1,000,000 sockeye-salmon eggs. The remainder of the eggs collected there during that season were transferred to the Harrison Lake hatchery. Since that time the Pitt Lake plant has been enlarged and is now a regular station.

In 1916 a subsidiary station was built by the Dominion on Cultus Lake to accommodate the surplus eggs which could not be handled in the Harrison and Pemberton hatcheries.

In 1913, the year of the quadrennially big run of sockeye salmon on the Fraser River, the contractors who were building the new Canadian Northern Railway, in blasting their way along the banks of the river, threw the rock and other débris into the stream until in the narrow part of the canyon south of North Bend at Whites Creek, Hells Gate, China Bar, and Scuzzy Rapids, all within a few miles of each other, the débris formed great sloping banks extending out into the stream at these points, and entirely changed the direction of the currents, and, of course, the velocity of the water. At best the salmon had a hard time getting through there, but the added obstructions rendered it practically impossible.

At a rather late hour the authorities woke up to the menace this work was to the run of salmon, and the dumping of débris into the river in such a manner as to obstruct their ascent was stopped.

How to clear the stream once more was now the problem, and this was seriously complicated by a slide of rock which took place in Hells Gate in February, 1914, which narrowed the channel of the stream considerably.

In March, 1914, the Dominion Marine and Fisheries Department contracted with a private concern to remove the obstructions, and this was done from Scuzzy Rapids, China Bar, and Whites Creek within a short period of time, but a couple of seasons' work were required to clear up Hells Gate so as to permit of passage for the fish. Some people claim that the fish still find it difficult to pass these obstructions.

Rivers Inlet.—A hatchery was established by the Dominion on McTavish Creek, one of the tributaries of Owikano Lake, about 20 miles up Rivers Inlet, in 1905, and has been operated ever since.

Skeena River.—In 1902 the Dominion established a hatchery on Lakelse Lake, in the Skeena River Basin, about 65 miles up the river from Port Essington. In 1919 a modern hatchery was commenced to replace the old one that was put out of commission by floods in 1917. In 1907 another was constructed on Babine Lake, the source of the Skeena River.

Vancouver Island.—In 1902 S. A. Spencer, of the Alert Bay cannery (now belonging to the British Columbia Packers Association), in return for certain special fishery privileges granted by the Dominion, established a hatchery on the Nimpkish River, which is located on the northeast shore of Vancouver Island. The hatchery was burned down in 1903, but was immediately rebuilt. Since its establishment operations were carried on by the Dominion, but it has not been operated since 1924.

In 1910 the Dominion put three new hatcheries into operation, all on Vancouver Island. They were located on Anderson Lake, Kennedy Lake, and Cowichan Lake, respectively. The two former are used for sockeyes and the latter for king and coho salmon and steelhead and other varieties of trout.

In 1915–16 the Draney Fisheries (Ltd.), operated a hatchery on a lake near by and hatched out 560,000 fry from eggs obtained from Rivers Inlet.

The following table shows the plantings made in the waters of British Columbia from the Dominion and provincial hatcheries:

Plants of salmon fry made in the waters of British Columbia

Year	Fraser River [1]						
	Chum	Coho, or silver	Spring, or king	Hump-back	Sockeye	Steelhead trout	Total
1885					1,800,000		1,800,000
1886					2,625,000		2,625,000
1887					4,414,000		4,414,000
1888					5,807,000		5,807,000
1889					4,419,000		4,419,000
1890					6,640,000		6,640,000
1891					3,603,800		3,603,800
1892					6,000,000		6,000,000
1893					5,674,000		5,674,000
1894					6,300,000		6,300,000
1895					6,390,000		6,390,000
1896					10,393,000		10,393,000
1897					5,928,000		5,928,000
1898					5,850,000		5,850,000
1899					4,742,000		4,742,000
1900					6,200,000		6,200,000
1902 [2]		90,000			15,808,000	75,000	15,973,000
1903	75,000	1,750,000	22,000		12,521,000		14,368,000
1904		210,000		50,000	13,729,200	12,000	14,001,200
1905		5,576,100	4,381,400		9,244,300		19,201,800
1906		4,774,000	1,791,500		100,479,000	4,000	107,048,500
1907		3,219,200	1,814,900		36,965,900		42,000,000
1908		5,890,000	2,815,000	22,500,000	51,855,200		83,060,200
1909		7,375,400	5,772,400		41,909,500		55,057,300
1910		450,000	6,300,000		105,312,500		112,062,500
1911		5,318,800	2,129,500		24,146,300		31,594,600
1912		3,899,500	5,962,500	28,773,350	34,183,850		72,819,200
1913	1,100,000	1,995,600	4,533,550		41,062,700		48,691,850
1914		1,522,000	50,000	500,000	92,308,000		94,380,000
1915	125,000	2,196,000	2,614,700		27,496,000		32,431,700
1916		1,652,000	2,540,000	[3] 3,834,000	[4] 67,201,000		75,227,000
1917 [5]	5,256,000	1,971,900	1,645,200	4,788,000	27,903,600		41,564,700
1918 [5]	378,000	1,729,800	2,763,000	13,940,100	37,153,350		55,964,250
1919	383,000	1,800,625	2,291,200	40,000	[6] 42,071,825	30,000	46,616,650
1920	5,154,300	469,800	3,529,800		32,820,750	90,000	42,064,650
1921	5,256,000	1,971,900	843,300	4,063,500	33,425,320		45,560,020
1922	2,778,003	231,300	1,366,200		31,315,095		35,690,598
1923		295,200	629,100	3,603,510	47,271,600	22,815	51,822,225
1924	205,200	59,400	519,750		43,623,900	3,600	44,411,850
1925				3,600	41,179,500	5,400	41,188,500
1926					51,152,657	4,950	51,157,607
1927					41,498,100	61,128	41,559,228
Total	20,710,503	54,448,525	54,315,000	82,096,060	1,190,423,947	308,893	1,402,302,928

[1] Some of the reports from the provincial hatchery at Seton Lake show merely the take of eggs; it has been necessary to make an arbitrary reduction in order to show the loss of eggs and fry before planting.
[2] No plants made in 1901.
[3] 3,549,000 were eggs.
[4] 3,242,000 were eggs.
[5] All were given as eggs, and an arbitrary reduction was made in order to show the loss in eggs and fry before planting.
[6] 500,000 were eggs; of the eggs from which the total plantings were made, 8,096,000 were obtained from the Skeena River.

Plants of salmon fry made in the waters of British Columbia—Continued

Year	Skeena River				Rivers Inlet			Nimpkish River, sockeye
	Coho	Humpback	Sockeye	Total	Spring, or king	Sockeye	Total	
1903			3,450,000	3,450,000				1,636,000
1904			4,000,000	4,000,000				2,496,000
1905			3,767,900	3,767,900				2,850,000
1906			3,784,450	3,784,450		8,000,000	8,000,000	4,873,400
1907			4,125,750	4,125,750		8,440,000	8,440,000	4,870,000
1908			8,946,950	8,946,950	4,706,000	8,594,000	13,300,000	4,800,000
1909			11,882,400	11,882,400		13,300,000	13,300,000	4,500,000
1910	80,000		11,441,700	11,521,700		12,750,000	12,750,000	5,055,000
1911			12,556,470	12,556,470		11,436,000	11,436,000	6,414,000
1912			12,367,500	12,367,500		11,791,000	11,791,000	5,114,500
1913			11,430,430	11,430,430		10,981,000	10,981,000	4,981,000
1914			11,843,200	11,843,200		12,397,000	12,397,000	5,053,000
1915		16,000	11,899,613	11,915,613		12,712,000	12,712,000	4,880,000
1916			11,202,257	11,202,257		12,594,100	12,594,100	4,980,000
1917			12,105,000	12,105,000		13,305,600	13,305,600	
1918			8,190,000	8,190,000		2,721,600	2,721,600	
1919			8,096,000	8,096,000		2,908,800	2,908,800	4,874,000
1920			15,393,600	15,393,600		10,869,300	10,869,300	5,180,000
1921			14,675,400	14,675,400		16,536,960	16,536,960	5,017,000
1922			14,728,500	14,728,500		13,131,090	13,131,090	5,017,000
1923			16,807,500	16,807,500		13,841,100	13,841,100	4,900,000
1924			15,350,400	15,350,400		14,389,200	14,389,200	[7]
1925	127,332		16,639,200	16,766,532		16,798,320	16,798,320	
1926			21,106,800	21,106,800		17,841,600	17,841,600	
1927			14,693,400	14,693,400		18,584,100	18,584,100	
Total	207,332	16,000	280,484,420	280,707,752	4,706,000	263,922,770	268,628,770	87,490,900

Year	Vancouver Island						
	Humpback	Chum	Coho, or silver	Spring, or king	Sockeye	Steelhead trout	Total
1911		40,000	4,550,000	425,000	7,862,000	145,200	13,022,200
1912			3,487,500	456,000	13,620,750	37,200	17,601,450
1913			3,180,000	712,500	15,031,750	173,900	19,098,150
1914			2,252,000	701,000	15,314,500	87,200	18,354,700
1915			2,229,220	250,600	15,911,000	55,000	18,445,820
1916			1,689,826	576,400	7,966,000	38,600	10,270,826
1917			1,426,860	1,209,600	2,862,000		5,498,460
1918			2,200,410	418,950	4,527,338		7,146,698
1919			2,152,194	[8] 431,760	[9] 4,589,250	[10] 33,798	7,207,002
1920			2,217,870	502,550	18,647,955	55,710	21,424,085
1921			1,179,675	1,364,670	10,698,480	85,410	13,328,235
1922			1,432,530	1,015,790	16,162,367	89,460	18,700,147
1923		2,610	1,512,000	336,600	12,427,290	16,470	14,294,970
1924				1,575,000	17,098,605	23,130	18,696,735
1925	3,240		743,300	638,550	15,477,840	149,130	17,012,060
1926				1,440,900	15,474,690	208,710	17,124,300
1927			472,500	1,020,600	10,666,503	170,280	12,329,883
Total	3,240	42,610	30,725,885	13,076,470	204,338,318	1,369,198	249,555,721

[7] Nimpkish hatchery closed, 1923.
[8] Includes 24,361 fingerlings.
[9] Includes 205,700 advanced fry and 26,000 fingerlings.
[10] Includes 5,357 fingerlings.

Plants of salmon fry made in the waters of British Columbia—Continued

Year	Total by species						Grand total
	Chum	Coho, or silver	Spring, or king	Hump-back	Sockeye	Steelhead trout	
1885					1,800,000		1,800,000
1886					2,625,000		2,625,000
1887					4,414,000		4,414,000
1888					5,807,000		5,807,000
1889					4,419,000		4,419,000
1890					6,640,000		6,640,000
1891					3,603,800		3,603,800
1892					6,000,000		6,000,000
1893					5,674,000		5,674,000
1894					6,300,000		6,300,000
1895					6,390,000		6,390,000
1896					10,393,000		10,393,000
1897					5,928,000		5,928,000
1898					5,850,000		5,850,000
1899					4,742,000		4,742,000
1900					6,200,000		6,200,000
1902		90,000			15,808,000	75,000	15,973,000
1903	75,000	1,750,000	22,000		17,607,000		19,454,000
1904		210,000		50,000	20,225,200	12,000	20,497,200
1905		5,576,100	4,381,400		15,862,200		25,819,700
1906		4,774,000	1,791,500		117,136,850	4,000	123,706,350
1907		3,219,200	1,814,900		54,401,650		59,435,750
1908		5,890,000	7,521,000	22,500,000	74,196,150		110,107,150
1909		7,375,400	5,772,400		71,591,900		84,739,700
1910		530,000	6,300,000		134,559,200		141,389,200
1911	40,000	9,868,800	2,554,500		62,414,770	145,200	75,023,270
1912		7,387,000	6,418,500	28,773,350	77,077,600	37,200	119,693,650
1913	1,100,000	5,175,600	5,246,050		83,486,880	173,900	95,182,430
1914		3,774,000	751,000	500,000	136,915,700	87,200	142,027,900
1915	125,000	4,425,220	2,865,300	16,000	72,898,613	55,000	80,385,133
1916		3,311,826	3,116,400	3,834,000	103,943,357	38,600	114,274,183
1917	5,256,000	3,398,760	2,854,800	4,788,000	56,176,200		72,473,760
1918	378,000	3,930,210	3,181,950	13,940,100	52,592,288		74,022,548
1919	383,000	3,952,819	2,722,960	40,000	62,539,875	63,798	69,702,452
1920	5,154,300	2,687,670	4,032,350		82,911,605	145,710	94,931,635
1921	5,256,000	3,151,575	2,207,970	4,063,500	80,353,160	85,410	95,117,615
1922	2,778,003	1,663,830	2,381,990		80,354,052	89,460	87,267,335
1923	2,610	1,807,200	965,700	3,603,150	95,247,490	39,285	101,665,795
1924	205,200	59,400	2,094,750		90,362,105	26,730	92,848,185
1925		870,732	638,550	6,840	90,094,860	154,530	91,765,412
1926			1,440,900		105,575,747	213,660	107,230,307
1927		472,500	1,020,600		85,442,103	231,408	87,166,611
Total	20,753,113	85,381,742	72,097,470	82,115,300	2,026,660,355	1,678,091	2,288,686,071

ALASKA

In 1891 several of the canneries operating at Karluk, on Kodiak Island, combined forces and built a hatchery on the lagoon at that place. As the cannery men were at swords points in regard to their fishing rights on the spit, in 1892 the hatchery was closed. In May, 1896, the Alaska Packers Association broke ground for a hatchery at the eastern end of the lagoon, near the outlet of Karluk River, a short distance from where the hatchery was located in 1891, and operated it until 1916, when it was abandoned as a hatchery.

In 1892 Capt. John C. Callbreath, manager of the Point Ellis cannery on Kuiu Island, operated a small hatchery on the left bank of Kutlakoo stream. It was a very primitive place, and an exceptionally high tide destroyed the whole plant in September. It was never rebuilt.

Captain Callbreath, however, after seeing to the operation of the hatchery, had returned to Wrangell during the summer, where his attention was again attracted to hatchery work, and in the fall of 1892 he built a small hatchery on Jadjeska stream, Etolin Island, about 200 yards from its mouth. The stream is about one-half mile in length and is the outlet of a small lake. Finding the location unsuitable, Captain Callbreath removed the hatchery in 1893 to the northern side of the lake, about three-eighths of a mile from the head of the outlet, where it still stands. The owner's intention was to build up a stream which had a small natural run of red salmon until it had a large run, with the hope that the Government would then give him the exclusive right to take these fish from the stream for commercial purposes. The experiment was kept up until the end of the season of 1905, when Captain Callbreath's failing eyesight compelled the cessation of the actual hatching. Until 1910 a man was stationed on the stream during the run of spawning fish for the purpose of lifting them over the dam, so that they could reach the spawning beds at the head of the lake, and the project was abandoned entirely shortly thereafter. The owner's expectation of a big run as a result of hatching operations was never realized.

In 1896 the Baranof Packing Co., which operated a cannery on Redfish Bay, on the western coast of Baranof Island, built a small hatchery on the lake at the head of Redfish stream. The following winter was so cold that not only the flume but the whole cataract froze solid, and as the hatchery was thus left without water the eggs were put into the lake and left to their fate and the hatchery closed down permanently.

In 1897 the North Pacific Trading & Packing Co., at Klawak, Prince of Wales Island, established a hatchery near the head of Klawak stream, close to Klawak Lake. In 1898 the plant was moved to the mouth of a small stream entering the lake about halfway up the western shore. This hatchery was operated continuously until the end of 1917, since when it has been shut down. In 1909 the North Alaska Salmon Co. acquired a half interest in it, which it relinquished to the original owners a few years later.

The Pacific Steam Whaling Co. in 1898 erected a small hatchery on Hetta Lake, on the west side of Prince of Wales Island, which was operated until the close of the hatching season of 1903–4, when the Pacific Packing & Navigation Co., successor to the original owner, went into the hands of a receiver. In 1907 it was reopened by the Northwestern Fisheries Co., which had acquired the interests of the old company, and was operated each season until the summer of 1918, when operations were discontinued.

Up to 1900 the work of hatching salmon was entirely voluntary on the part of the packers. On May 2 of that year the following regulation was promulgated at the Treasury Department, which at that time had control of the Alaska salmon-inspection service:

7. Each person, company, or corporation taking salmon in Alaskan waters shall establish and conduct, at or near the fisheries operated by him or them, a suitable artificial propagating plant or hatchery, and shall produce yearly and place in the natural spawning waters of each fishery so operated red-salmon fry in such numbers as shall be equal to at least four times the number of mature fish taken from the said fisheries by or for him or them during the preceding fishing season. The management and operation of such hatcheries shall be subject to such rules and regulations as may hereafter be prescribed by the Secretary of the Treasury. They shall be open for inspection by the authorized official of this department; annual reports shall be made, giving full particulars of the number of male and female salmon stripped, the number of eggs treated, the number and percentage of fish hatched, and all other conditions of interest; and there shall be made a sworn yearly statement of the number of fry planted and the exact location where said planting was done.

On January 24, 1902, this regulation was amended so as to require the planting of "red-salmon fry in such numbers as shall be equal to at least ten times the number of salmon of all varieties taken from the said fisheries."

Although the regulation was mandatory, but few of the packers obeyed it, some because no suitable place was to be found within a reasonable distance of their plants, others because the establishment and operation of such a hatchery would cost more than their returns from the industry justified, and others because of lack of knowledge required in hatchery work. The greater number of them absolutely ignored it, and as a result those who conformed to the regulation were placed under a heavy financial handicap. The injustice of this arrangement was patent on its face, and in 1906, when a comprehensive revision of the law was made by Congress, provision was made for reimbursing in the future those cannery men who operated salmon hatcheries. The section covering this point reads as follows:

SEC. 2. That the catch and pack of salmon made in Alaska by the owners of private salmon hatcheries operated in Alaska shall be exempt from all license fees and taxation of every nature at the rate of ten cases of canned salmon to every one thousand red or king salmon fry liberated, upon the following conditions:

That the Secretary of Commerce and Labor may from time to time, and on the application of the hatchery owner shall, within a reasonable time thereafter, cause such private hatcheries to be inspected for the purpose of determining the character of their operations, efficiency, and productiveness, and if he approve the same shall cause notice of such approval to be filed in the office of the clerk or deputy clerk of the United States district court of the division of the District of Alaska wherein any such hatchery is located, and shall also notify the owners of such hatchery of the action taken by him. The owner, agent, officer, or superintendent of any hatchery the effectiveness and productiveness of which has been approved as above provided shall, between the thirtieth day of June and the thirty-first day of December of each year, make proof of the number of salmon fry liberated during the twelve months immediately preceding the thirtieth day of June by a written statement under oath. Such proof shall be filed in the office of the clerk or deputy clerk of the United States district court of the division of the District of Alaska wherein such hatchery is located, and when so filed shall entitle the respective hatchery owners to the exemption as herein provided; and a false oath as to the number of salmon fry liberated shall be deemed perjury and subject the offender to all the pains and penalties thereof. Duplicates of such statements shall also be filed with the Secretary of Commerce and Labor.

It shall be the duty of such clerk or deputy clerk in whose office the approval and proof heretofore provided for are filed to forthwith issue to the hatchery owner, causing such proofs to be filed, certificates which shall not be transferable and of such denominations as said owner may request (no certificate to cover fewer than one thousand fry), covering in the aggregate the number of fry so proved to have been liberated; and such certificates may be used at any time by the person, company, corporation, or association to whom issued for the payment pro tanto of any license fees or taxes upon or against or on account of any catch or pack of salmon made by them in Alaska; and it shall be the duty of all public officials charged with the duty of collecting or receiving such license fees or taxes to accept such certificates in lieu of money in payment of all license fees or taxes upon or against the pack of canned salmon at the ratio of one thousand fry for each ten cases of salmon. No hatchery owner shall obtain the rebates from the output of any hatchery to which he might otherwise be entitled under this act unless the efficiency of said hatchery has first been approved by the Secretary of Commerce and Labor in the manner herein provided for, In 1901 the Pacific Steam Whaling Co. established two small hatcheries—one on Nagel Stream, which enters the northern side of Quadra Lake, on the mainland of southeast Alaska, and one on a stream entering Freshwater Lake Bay, Chatham Strait. Both were closed down in 1904 when the company failed. In 1908 the Northwestern Fisheries Co., which had acquired the Quadra plant, removed it to a small stream entering the head of the lake and has operated it ever since.

In 1901 the Alaska Packers Association erected a hatchery on Heckman Lake, the third of a series of lakes on Naha Stream, Revillagigedo Island, and about 8 miles from Loring, where the association has a cannery. This, known as Fortmann hatchery, was the largest and costliest salmon hatchery in the world, having a capacity of 110,000,000 eggs. Its operation was discontinued in 1927.

The Union Packing Co., at Kell Bay, on Kuiu Island, and F. C. Barnes, at Lake Bay, on Prince of Wales Island, in 1902 built and operated small hatcheries, both of which were abandoned after one season's work.

Up to 1905 the work of hatching salmon in Alaska was confined to the salmon cannery men. In that year, however, the United States Bureau of Fisheries erected a hatchery on Yes Lake, which empties through a short stream into Yes Bay, on Cleveland Peninsula. In 1907 the bureau constructed another hatchery, on Afognak Lake, near Litnik Bay, Afognak Island.

The eruption of Katmai volcano, on the Alaska Peninsula, June 6, 1912, covered the island of Afognak with volcanic ash and sand to an average depth of 9 inches. It is estimated that 20,000 salmon perished at the head of Litnik Lake, while thousands were driven back into the ocean. As a result of these conditions the work at the Afognak station was much hampered and curtailed. Even as late as 1915 work at this station was still being hampered by the volcanic ash and sand which fell in 1912.

In 1913 collecting stations were established at Eagle Harbor and Uganik Lake, on Kodiak Island. In 1915 another was established at Seal Bay, on Afognak Island. These were subsidiary to the Afognak hatchery.

In 1913 a collecting station was established on Ketchikan Creek, but, owing to the objections of the citizens of the town against the taking away of the eggs, the station was abandoned in 1915.

The tables following show the eggs and fry distributed by the Government and privately owned hatcheries in Alaska.

112992°—10——18

Output of the salmon hatcheries in Alaska owned by the United States Bureau of Fisheries, 1906 to 1928

McDONALD LAKE OR YES BAY HATCHERY

Year ending June 30—	Red or sockeye		Coho or silver fry	Steelhead fry	Pink or humpback		Total	
	Eggs	Fry and fingerlings			Eggs	Fry and fingerlings	Eggs	Fry and fingerlings
1906		6,638,550						6,638,550
1907		54,610,800		143,500				54,754,300
1908		61,369,000						61,369,000
1909		48,653,000	9,900					48,662,900
1910		69,879,600						69,879,600
1911	[1] 1,500,000	68,239,900			100,000		1,600,000	68,239,900
1912	[1] 2,000,000	68,335,000					2,000,000	68,335,000
1913	[1] 2,000,000	60,422,100					2,000,000	60,422,100
1914	[1] 2,000,000	42,726,400				4,500,000	2,000,000	47,226,400
1915	[1] 3,000,000	37,445,000			[2] 2,000,000		5,000,000	37,445,000
1916	[3] 18,100,000	52,317,500				325,000	18,100,000	52,642,500
1917	[1] 2,000,000	51,175,000					2,000,000	51,175,000
1918		32,539,200						32,539,200
1919	[4] 4,500,000	32,650,000			[2] 406,000	930,000	4,906,000	33,580,000
1920		9,387,000						9,387,000
1921 [5]		4,025,000						4,025,000
1922	150,000	47,640,000				210,000	150,000	47,850,000
1923		24,099,045				393,600		24,492,645
1924		21,817,800						21,817,800
1925		27,382,000						27,382,000
1926	[6] 8,645,760	27,392,200					8,645,760	27,392,200
1927	[7] 6,958,890	20,467,000					6,958,890	20,467,000
1928		18,784,715						18,784,715
Total	50,854,650	887,995,810	9,900	143,500	2,506,000	6,358,600	53,360,650	894,507,810

AFOGNAK HATCHERY

Year ending June 30—	Red or sockeye		Coho or silver fry	Steelhead fry	Pink or humpback		Total	
	Eggs	Fry and fingerlings			Eggs	Fry and fingerlings	Eggs	Fry and fingerlings
1909		39,325,870				10,000		39,335,870
1910		71,647,170				363,740		72,010,910
1911		26,755,000				364,150		27,119,150
1912		18,394,700				5,829,300		24,224,000
1913		12,551,100	214,000			151,800		12,916,900
1914	3,970,000	7,761,705	50,000			12,034,399	3,970,000	19,846,104
1915		6,387,080			[8] 12,500,000	343,480	12,500,000	6,730,560
1916		[9] 22,933,640				6,736,500		29,670,140
1917		21,116,000			[10] 16,000,000	19,343,000	16,000,000	40,459,000
1918	[11] 18,000,000	31,427,000				1,326,000	18,000,000	32,753,000
1919	[12] 25,700,000	25,583,000			[13] 5,760,000	2,142,000	31,460,000	27,725,000
1920	[14] 10,000,000	61,524,000					10,000,000	61,524,000
1921	[15] 10,340,500	47,808,000					10,340,500	47,808,000
1922	[1] 5,200,000	32,580,000					5,200,000	32,580,000
1923	[16] 10,678,400	46,333,000			[2] 278,616	240,000	10,957,016	46,573,000
1924 [17]								
1925 [17]								
1926		10,075,000		[18] 850,000				10,925,000
1927	[19] 3,402,000	14,400,000		([20])	[21] 3,617,000		7,019,000	14,400,000
1928		3,675,000						3,675,000
Total	87,290,900	500,277,265	264,000	850,000	38,155,616	48,884,369	125,446,516	550,275,634

See footnotes at end of table.

Output of the salmon hatcheries in Alaska owned by the United States Bureau of Fisheries, 1906 to 1928—Continued

SUMMARY

Year ending June 30—	Total, by species, both hatcheries						Grand total	
	Red or sockeye		Coho or silver fry	Steelhead fry	Humpback			
	Eggs	Fry and fingerlings			Eggs	Fry and fingerlings	Eggs	Fry and fingerlings
1906		6, 638, 550						6, 638, 550
1907		54, 610, 800		143, 500				54, 754, 300
1908		61, 369, 000						61, 369, 000
1909		87, 978, 870	9, 900			10, 000		87, 998, 770
1910		141, 526, 770				363, 740		141, 890, 510
1911	1, 500, 000	94, 994, 900			100, 000	364, 150	1, 600, 000	95, 359, 050
1912	2, 000, 000	86, 729, 700				5, 829, 300	2, 000, 000	92, 559, 000
1913	2, 000, 000	72, 973, 200	214, 000			151, 800	2, 000, 000	73, 339, 000
1914	5, 970, 000	50, 488, 105	50, 000			16, 534, 399	5, 970, 000	67, 072, 504
1915	3, 000, 000	43, 832, 080			14, 500, 000	343, 480	17, 500, 000	44, 175, 560
1916	3, 100, 000	75, 251, 140				7, 061, 500	[22] 3, 100, 000	82, 312, 640
1917	2, 000, 000	72, 291, 000			16, 000, 000	19, 343, 000	18, 000, 000	91, 634, 000
1918	18, 000, 000	63, 966, 200				1, 326, 000	18, 000, 000	65, 292, 200
1919	30, 200, 000	58, 233, 000			6, 166, 000	3, 072, 000	36, 366, 000	61, 305, 000
1920	10, 000, 000	70, 911, 000					10, 000, 000	70, 911, 000
1921	10, 340, 500	51, 833, 000					10, 340, 500	51, 833, 000
1922	5, 350, 000	80, 220, 000				210, 000	5, 350, 000	80, 430, 000
1923	10, 678, 400	70, 432, 045			278, 616	633, 600	10, 957, 016	71, 065, 645
1924		21, 817, 800						21, 817, 800
1925		27, 382, 000						27, 382, 000
1926	8, 645, 760	37, 467, 200		850, 000			8, 645, 760	38, 317, 200
1927	10, 360, 890	34, 867, 000		([23])	3, 617, 000		13, 977, 890	34, 867, 000
1928		22, 459, 715						22, 459, 715
Total	123, 145, 550	1,388,273,075	273, 900	993, 500	40, 661, 616	55, 242, 969	163, 807, 166	1, 444, 783, 444

[1] Shipped to Oregon Fish Commission.
[2] Shipped to bureau's hatchery at Birdsview, Wash.
[3] 15,000,000 eggs were transferred to the bureau's hatchery at Afognak, 100,000 to the Quinault (Wash.) hatchery, and 3,000,000 to Oregon Fish Commission.
[4] 1,059,000 were shipped to the Little White Salmon hatchery and 3,440,100 to the Oregon Fish Commission.
[5] No eggs were collected in 1920 owing to repair work which could be done only in summer months.
[6] 5,645,000 were shipped to the bureau's station at Baker Lake, Wash., and 3,000,760 to the Oregon Fish Commission.
[7] 5,241,130 were shipped to Seattle and 1,717,760 to the Territorial hatchery at Ketchikan.
[8] 7,000,000 were shipped to Government hatcheries in Maine and 5,500,000 to bureau's stations in Washington.
[9] Of the eggs from which these fry and fingerlings were hatched, 15,000,000 came from Yes Bay hatchery.
[10] Shipped to bureau's stations in New England States and in Washington—8,000,000 to each region.
[11] Shipped to Seattle for distribution: 10,000,000 to the Province of British Columbia, 5,000,000 to the bureau's station at Quinault, Wash., and 3,000,000 to the Oregon Fish Commission.
[12] 5,000,000 were shipped to the bureau's Quinault (Wash.) hatchery and 20,700,000 to the Province of British Columbia.
[13] Shipped to the bureau's Puget Sound hatcheries.
[14] 7,000,000 were shipped to the bureau's Quinault (Wash.) station and 3,000,000 to the Oregon State hatchery at Bonneville.
[15] 5,000,000 were shipped to McDonald Lake, 2,340,500 to Quinault, Wash., and 3,000,000 to the Oregon State hatchery at Bonneville.
[16] 5,098,936 were shipped to Alaska Territorial Fish Commission at Juneau, 5,045,000 to Oregon Fish Commission at Bonneville, and 534,464 to the State fish commission at Seattle, Wash.
[17] Hatchery being rebuilt.
[18] 1,023,360 eyed eggs were shipped to Puget Sound hatcheries.
[19] Shipped to Seattle for distribution.
[20] 1,090,000 eggs were collected and the resulting 790,400 eyed eggs were shipped to Seattle for distribution.
[21] Shipped to Quilcene (Wash.) station.
[22] 15,000,000 of the red salmon eggs shown under Yes Bay were transferred to Afognak, hatched out there and the fry counted under the "Fry" column of that hatchery.
[23] Eggs taken were shipped to Seattle for distribution.

Take of eggs and output of private salmon hatcheries of Alaska, 1893 to 1919

[Unless otherwise stated in footnotes, all of the fry liberated were red salmon.]

Year ending June 30—	Callbreath's hatchery		Karluk hatchery		Klawak hatchery	
	Eggs	Fry	Eggs	Fry	Eggs	Fry
1893	900,000	600,000				
1894	3,000,000	2,204,000				
1895	6,300,000	5,291,000				
1896	6,200,000	5,475,000				
1897	4,400,000	4,390,000	3,236,000	2,556,440		
1898	3,400,000	2,526,000	8,454,000	6,340,000	2,023,000	800,000
1899	3,000,000	2,050,000	4,491,000	3,369,000	3,600,000	3,000,000
1900	3,400,000	2,335,000	10,496,900	7,872,000	3,600,000	[1] 1,000,000
1901	(2)		19,334,000	15,566,800	(3)	
1902	6,000,000	5,500,000	32,800,000	28,700,000	3,500,000	2,800,000
1903	6,000,000	5,000,000	23,400,000	17,555,000	3,500,000	1,500,000
1904	6,000,000	5,000,000	28,113,000	22,000,000	3,000,000	1,700,000
1905	6,050,000	5,250,000	45,500,000	33,670,000	2,800,000	2,000,000
1906	7,700,000	6,500,000	36,933,000	28,236,412	2,800,000	2,300,000
1907	(4)	(4)	38,679,200	36,846,000	3,600,000	1,187,000
1908	(5)	(5)	47,808,200	43,655,000	3,500,000	2,776,000
1909	(5)	(5)	40,320,000	37,105,000	3,500,000	3,200,000
1910	(5)	(5)	45,228,000	40,620,000	5,800,000	5,300,000
1911	(5)	(5)	49,626,000	37,722,000	6,786,500	6,200,000
1912	(6)	(6)	41,026,800	37,495,100	5,600,000	3,530,000
1913	(6)	(6)	45,600,000	41,803,155	3,835,000	3,675,000
1914	(6)	(6)	34,629,160	31,546,080	3,645,000	3,465,000
1915	(6)	(6)	[7] 30,240,000	27,704,000	3,816,000	3,653,000
1916	(6)	(6)	41,135,000	23,948,000	4,180,000	4,020,000
1917	(6)	(6)	[8] 1,016,000	(6)	8,160,000	7,822,000
1918	(6)	(6)	(6)	(6)	(6)	(6)
1919	(6)	(6)	(6)	(6)	(6)	(6)
Total	[9] 62,350,000	52,121,000	628,066,260	524,309,987	77,245,500	59,928,000

Year ending June 30—	Hetta hatchery		Quadra Bay hatchery		Freshwater Bay hatchery	
	Eggs	Fry	Eggs	Fry	Eggs	Fry
1899	2,800,000	2,600,000				
1900	2,000,000	1,500,000				
1901	1,800,000	[1] 500,000				
1902	2,500,000	1,700,000	4,500,000	3,500,000	1,500,000	1,000,000
1903	4,800,000	4,000,000	5,500,000	4,000,000	(2)	(2)
1904	5,127,500	3,750,000	600,000	[3] 400,000	(4)	(4)
1905	(6)	(6)	(6)	(6)	(6)	(6)
1906	(6)	(6)	(6)	(6)	(6)	(6)
1907	(6)	(6)	(6)	(6)	(6)	(6)
1908	8,000,000	6,125,000	(6)	(6)	(6)	(6)
1909	8,400,000	8,134,000	3,325,000	3,025,750	(6)	(6)
1910	10,313,000	9,000,000	10,863,000	9,850,000	(6)	(6)
1911	9,141,000	8,552,500	11,200,000	10,350,000	(6)	(6)
1912	2,585,000	2,342,000	11,000,000	10,166,000	(6)	(6)
1913	3,780,000	3,592,000	10,000,000	8,127,000	(6)	(6)
1914	4,082,000	3,590,500	18,400,000	17,054,000	(6)	(6)
1915	7,438,500	7,142,500	21,300,000	20,300,000	(6)	(6)
1916	7,408,000	7,092,000	8,114,000	7,598,000	(6)	(6)
1917	3,247,000	3,120,000	16,125,000	15,003,000	(6)	(6)
1918	4,826,000	4,587,000	13,600,000	12,990,000	(6)	(6)
1919	(6)	(6)	20,400,000	19,852,000	(6)	(6)
1920	(6)	(6)	11,710,000	11,357,000	(6)	(6)
1921	(6)	(6)	19,450,000	18,913,000	(6)	(6)
1922	(6)	(6)	9,985,000	9,647,000	(6)	(6)
1923	(6)	(6)	6,195,000	6,007,000	(6)	(6)
1924	(6)	(6)	17,885,000	17,234,000	(6)	(6)
1925	(6)	(6)	20,050,000	19,430,000	(6)	(6)
1926	(6)	(6)	20,240,000	19,345,000	(6)	(6)
1927	(6)	(6)	20,000,000	19,340,000	(6)	(6)
1928	(6)	(6)	20,240,000	19,360,000	(6)	(6)
Total	88,248,000	77,327,500	300,682,000	282,848,750	1,500,000	1,000,000

[1] Many eggs frozen.
[2] No run of fish.
[3] Hatchery was not used, the eggs being hatched out in the lake.
[4] No report.
[5] Fish coming in to spawn were lifted over the dam.
[6] Not operated.
[7] A collection of 7,400,000 humpback eggs was made for Afognak, and these appear in the report of that hatchery.
[8] These eggs were turned over to the Afognak hatchery and the hatchery shut down.
[9] A considerable portion of these are coho eggs.

Take of eggs and output of private salmon hatcheries of Alaska, 1893 to 1919—Continued

Year ending June 30—	Fortmann hatchery		Kell Bay hatchery		Total	
	Eggs	Fry	Eggs	Fry	Eggs	Fry
1893					900, 000	600, 000
1894					3, 000, 000	2, 204, 000
1895					6, 300, 000	5, 291, 000
1896					6, 200, 000	5, 475, 000
1897					7, 636, 000	6, 946, 440
1898					13, 877, 000	9, 666, 000
1899					13, 891, 000	11, 019, 000
1900					19, 496, 900	12, 707, 000
1901					21, 134, 000	16, 066, 800
1902	11, 460, 000	10, 300, 000			62, 260, 000	53, 500, 000
1903	40, 050, 000	29, 005, 000	2, 500, 000	2, 000, 000	85, 750, 000	63, 060, 000
1904	22, 203, 000	13, 780, 000	[6]	[6]	65, 043, 500	46, 630, 000
1905	65, 010, 000	63, 181, 000	[6]	[6]	119, 360, 000	104, 101, 000
1906	68, 715, 000	67, 643, 000	[6]	[6]	116, 148, 000	104, 679, 412
1907	105, 450, 000	80, 973, 000	[6]	[6]	147, 729, 200	119, 006, 000
1908	[10] 41, 280, 000	33, 920, 000	[6]	[6]	100, 588, 200	86, 476, 000
1909	24, 465, 000	22, 785, 000	[6]	[6]	80, 010, 000	74, 249, 750
1910	53, 340, 000	50, 725, 000	[6]	[6]	125, 544, 000	115, 495, 000
1911	34, 920, 000	30, 245, 000	[6]	[6]	111, 673, 500	93, 069, 500
1912	107, 520, 000	100, 335, 000	[6]	[6]	167, 731, 800	153, 868, 100
1913	23, 160, 000	20, 800, 000	[6]	[6]	86, 375, 000	77, 997, 155
1914	9, 480, 000	8, 700, 000	[6]	[6]	70, 236, 160	64, 355, 580
1915	22, 500, 000	20, 820, 000	[6]	[6]	85, 294, 500	79, 619, 500
1916	26, 520, 000	[11] 25, 615, 000	[6]	[6]	87, 357, 000	68, 273, 000
1917	62, 580, 000	57, 405, 000	[6]	[6]	91, 128, 000	83, 350, 000
1918	[12] 4, 240, 000	[13] 7, 980, 000	[6]	[6]	22, 666, 000	25, 557, 000
1919	[14] 23, 280, 000	15, 205, 000	[6]	[6]	43, 680, 000	35, 057, 000
1920	18, 420, 000	17, 070, 000	[6]	[6]	30, 130, 000	28, 427, 000
1921	[15] 18, 600, 000	[16] 17, 720, 000	[6]	[6]	38, 050, 000	36, 633, 000
1922	[17] 14, 280, 000	[18] 13, 715, 000	[6]	[6]	24, 265, 000	23, 362, 000
1923	[19] 18, 000, 000	[20] 17, 205, 000	[6]	[6]	24, 195, 000	23, 212, 000
1924	[21] 16, 680, 000	[22] 15, 025, 000	[6]	[6]	34, 565, 000	32, 259, 000
1925	[23] 12, 540, 000	[24] 11, 810, 000	[6]	[6]	32, 590, 000	31, 240, 000
1926	[25] 21, 600, 000	[26] 20, 173, 000	[6]	[6]	41, 840, 000	39, 518, 000
1927	[27] 24, 060, 000	[28] 21, 320, 384	[6]	[6]	44, 060, 000	40, 660, 384
1928	[6]	[6]	[6]	[6]	20, 240, 000	19, 360, 000
Total	890, 353, 000	793, 455, 384	2, 500, 000	2, 000, 000	2, 050, 944, 760	1, 792, 990, 621

[6] Not operated.
[10] Includes 30,000 coho eggs taken and 27,000 fry liberated.
[11] Includes 600,000 humpback eggs taken and 560,000 fry liberated.
[12] Includes 2,400,000 humpback eggs taken.
[13] Includes 1,845,000 humpback fry planted.
[14] Includes 3,660,000 humpback eggs.
[15] Includes 360,000 humpback eggs.
[16] Includes 345,000 humpback fry.
[17] Includes 900,000 humpback eggs.
[18] Includes 830,000 humpback fry.
[19] Includes 240,000 humpback eggs.
[20] Includes 220,000 humpback fry.
[21] Includes 1,200,000 humpback eggs.
[22] Includes 1,150,000 humpback fry.
[23] Includes 900,000 humpback eggs.
[24] Includes 805,000 humpback fry.
[25] Includes 4,680,000 humpback eggs.
[26] Includes 4,183,000 humpback fry.
[27] Includes 2,640,000 humpback eggs.
[28] Includes 2,490,000 humpback fry.

Take of eggs and output of salmon hatcheries in Alaska owned by the Territorial government

JUNEAU [1]

Year ending Mar. 31—	Red or sockeye		Coho or silver		Chum	
	Eggs	Fry	Eggs	Fry	Eggs	Fry
1920			10,540,000	[2] 9,175,000	3,425,000	[2] 3,250,000
1921	670,000	[2] 134,000	6,460,000	[2] 5,730,000	5,250,000	[3] 5,000,000
1922		500,000	5,300,000	[5] 5,450,000		
1923	[8] 6,043,936	5,712,000		[9] 100,000		

Year ending Mar. 31—	Humpback		Chinook		Total	
	Eggs	Fry	Eggs	Fry	Eggs	Fry
1920	890,000	[2] 840,000			14,855,000	[3] 13,265,000
1921	4,640,000	[2] 3,410,000			17,020,000	[4] 14,274,000
1922	1,000,000	[6] 1,950,000			6,300,000	[7] 7,900,000
1923	250,000	121,000			6,293,936	5,933,000

KETCHIKAN

Year ending Mar. 31—	Red or sockeye		Coho or silver		Chum	
	Eggs	Fry	Eggs	Fry	Eggs	Fry
1925					2,640,000	
1926	165,000				320,000	[9] 2,501,000
1927	3,337,760	[9] 100,000			451,000	265,000
1928 [13]		[9] 2,625,000				[14] 225,000

Year ending Mar. 31—	Humpback		Chinook		Total	
	Eggs	Fry	Eggs	Fry	Eggs	Fry
1924	13,167,000	[10] 1,800,000	[11] 1,000,000		14,167,000	1,800,000
1925	3,447,000	9,401,000	[12] 2,000,000	985,000	8,087,000	10,386,000
1926	11,415,000	[9] 2,946,000	[12] 2,000,000	[9] 1,930,000	13,900,000	7,377,000
1927	1,660,000	9,729,000	[12] 2,000,000	[9] 1,789,000	7,448,760	11,883,000
1928 [13]		1,524,000		[9] 1,819,000		6,193,000

OTHER DISTRICTS

Year	Eyak Lake, Cordova				Seward, red or sockeye	
	Red or sockeye		Chinook			
	Eggs	Fry	Eggs	Fry	Eggs	Fry
1922	4,800,000	[15] 4,600,000				
1923	3,134,000	[15] 3,078,000				
1924	4,504,000	4,120,000				
1925	5,250,000	[16] 1,700,000	[12] 571,000		1,015,000	
1926	7,530,300	3,242,150		523,500	4,460,544	[9] 846,360
1927		7,300,000			3,164,000	4,085,727
1928						(17)
Total	25,218,300	24,040,150	571,000	523,500	8,639,544	4,932,087

See footnotes at end of table.

Take of eggs and output of salmon hatcheries in Alaska owned by the Territorial government—Continued

Year	Seward—Continued, chinook		Total Cordova and Seward		Grand total	
	Eggs	Fry	Eggs	Fry	Eggs	Fry
1920					14, 855, 000	13, 265, 000
1921					17, 020, 000	14, 274, 0C0
1922			4, 800, 000	4, 600, 000	11, 100, 000	12, 500, 000
1923			3, 134, 000	3, 078, 000	9, 427, 936	9, 011, 000
1924			4, 504, 000	4, 120, 000	18, 671, 000	5, 920, 000
1925	[12] 1, 429, 000		8, 265, 000	1, 700, 000	16, 352, 000	12, 086, 000
1926		[9] 1, 387, 000	11, 990, 844	5, 999, 010	25, 890, 844	13, 376, 010
1927			3, 164, 000	11, 385, 727	10, 612, 760	23, 268, 727
1928						6, 193, 000
Total	1, 429, 000	1, 387, 000	35, 857, 844	30, 882, 737	123, 929, 540	109, 893, 737

[1] Hatchery transferred from Juneau to Ketchikan in summer of 1923.
[2] Includes planting of eyed eggs and fertilized as well as fry.
[3] Includes 6,815,000 eyed eggs, 5,250,000 fertilized eggs, and 1,200,000 fry.
[4] Includes 4,885,000 eyed eggs, 6,470,000 fertilized eggs, and 2,919,000 fry.
[5] Includes planting of 1,000,000 eyed eggs.
[6] Includes planting of 450,000 eyed eggs.
[7] Includes 500,000 red, 400,000 coho, 1,000,000 humpback fry held in hatchery from 1920.
[8] Includes 5,098,936 eggs received from Afognak, and 945,000 from Auk Lake.
[9] Fingerlings.
[10] 1,800,000 eyed eggs transferred to State of Oregon.
[11] 500,000 eggs received from State of Oregon, and 500,000 from U. S. Bureau of Fisheries.
[12] Eggs received from State of Washington.
[13] Territorial hatcheries closed by Territorial legislature at end of year 1928.
[14] 200,000 fry lost because of accidental shut-off of water supply.
[15] Fertilized eggs.
[16] Eggs planted at Eshamy.
[17] Fire, Mar. 9, 1927, destroyed hatchery with all stock on hand.

THE SALMON FISHERIES OF SIBERIA

As on the Alaska coast, the aborigines of Siberia must have learned early of the excellent food qualities of the salmon which each year frequented the rivers of that country for spawning purposes, and not only ate them fresh but also dried large quantities for winter use for themselves and their dogs.

Owing to the inaccessibility of the Siberian coast, due mainly to the lack of transportation facilities for many years and the decided objection of the Russian Government to travelers roaming over the country, partly because of the presence of political and criminal convicts and partly because of a fear that they might learn too much of its resources, there has been but little written, especially with regard to its fishery resources, about this remote section of the Russian Empire, and what little has been published is usually filled with inaccuracies, due, doubtless, in many instances to the fact that the writer generally had to get most of his information at second and third hand and was also unfamiliar with fishery subjects.

Most of the data given below were obtained directly from persons living in Siberia or Japan, most of whom are engaged in the fishing industry of Siberia, or from Americans who have on various occasions visited the country in order to view its fishing possibilities at first hand.

SPECIES OF SALMON

All five species of salmon are to be found along the Siberian coast, and the schools appear to run about the same as they do on the American side. Although we have very little authentic data relating to their movements, these are doubtless similar to the runs on the Alaska coast, where climatic and other conditions are very similar. Nearly all streams from the Arctic Ocean to North China seem to have runs of one or more species. The steelhead does not appear to be an inhabitant of the Asian coast.

The fishing carried on by the Russians has usually been along the rivers of the mainland, principally in the Amur and on Sakhalin Island.

From very early times Japanese fishermen have frequented the Siberian coast and Sakhalin Island (the southern portion of which they at one time owned, exchanging it to Russia for the Kurile Islands in 1875 and again acquiring it in 1905, as a result of the Russian-Japanese war), being drawn here mainly by the rich stores of salmon which could be secured easily and quickly, and were so necessary to eke out the vast quantity needed to supply such a fish-eating nation as Japan.

FISHING DISTRICTS

The Priamur fishing district is subdivided into several districts as follows:

Nikolaevsk district.—This district comprises the whole lower part of the Amur River from the village Zimmermanovka down to the mouth of the river, about 300 miles; the River Amgun, 200 miles; the Amur estuary, about 150 miles on the mainland and about 130 miles on the coast of Sakhalin Island, and about 865 miles of the coast line on the southwestern shore of the Okhotsk Sea. In 1913 there were 139 fishing stations operated in this district, and this number had been materially increased since. Humpbacks and chums were the principal species of salmon taken.

Sakhalin district.—The Sakhalin district includes the entire coast line of Sakhalin Island with the exception of that facing the Amur estuary, which belongs to the Nikolaevsk district. It is the smallest district, and at present is of little importance. In 1913 there were 14 stations on the island and they produced chum and humpback salmon.

Okhotsk-Kamchatka district.—The Okhotsk section covers the coast line of the northern part of the Okhotsk Sea from Port Ayan to Penjin Promontory, about 1,620 miles. Chum, humpback, coho, and red salmon, and Dolly Varden trout are found here. The West Kamchatka section includes the coast line from the Sopotshnaya River down to the southern Ozernof shore fishing stations, a distance of about 335 miles. The Ozernaya River is, so far as known, the only river in this section that the red salmon visit in any quantities. In 1913 there were 152 fishing stations in this section, most of which were leased to Japanese. The number has since been increased. All five species of salmon and the Dolly Varden trout are found here. The East Kamchatka section covers the coast line of eastern Kamchatka and Anadir Peninsulas, about 1,843 miles. The majority of the fishing stations are concentrated around Karaginsky (Count Litka) Bay, in the straits from the Malo-Voyam River to Kitchigin

River, about 135 miles long, and in the region of Kamchatka River. All five species of salmon and Dolly Varden trout are taken here and most of the canneries are located here and in the West Kamchatka section.

Southwestern district.—This district covers the waters from the southern boundary of the Amur River estuary (the line between Capes Lazarev and Pogibi) down to the Chosen frontier, including Vanina Bay, Imperial Harbor, Peter the Great Bay, and other bays. The total length of the shore line is about 1,350 miles. The northern part, from Lazarev-Pogibi line to Cape Povorotni, with the exception of various bays, includes the conventional waters, while the southern part, composed of Peter the Great Bay and Posiet Bay, are excluded from the conventional waters. In the first-named section chum and humpback salmon are caught to some extent. In the southern section chum and humpback salmon are taken and marketed fresh.

Amur River.—The Amur River is subdivided into two districts—the Marinsk, or the Lower Amur, district and the Khabarovsk district. The first named includes the area from the village Troitskoe to the village Sophiskoe, or a tract about 278 miles long. The Khabarovsk district includes the river line from the northern boundary of the Maryinsk district up the river to Khabarovsk, about 127 miles. Chum salmon form the bulk of the catch in this district.

APPARATUS EMPLOYED

In the river districts somewhat primitive fishing apparatus is employed. Spears, dip nets, and the other simple forms which seem to be common to all savage tribes depending upon the water for the greater part of their subsistence, are all in use by the natives living along the upper reaches.

Weirs of a primitive type known as "zaezdka," are also used. These have a lead consisting of willow poles and branches built from the river bank or a sand bank out into the stream. At the outer end is attached a net compartment with a lead, into which the fish, which have been following the lead in the search for an opening, pass. Two men in a boat are anchored close by, and as soon as 30 or 40 salmon have passed into the compartment, it is hauled up and the fish emptied into the boat, after which the net is reset.

Haul seines of varying lengths and depths are used in connection with the more important river fishing stations.

Along the coast the Japanese use a floating trap net somewhat similar to the type used in Alaska, also haul seines and a few gill nets.

ABUNDANCE OF SALMON

It is exceedingly difficult to secure even approximate statistics of the Siberian catch of salmon, owing to the wide extent of coast, the totally inadequate means of transportation preventing close supervision, the presence of so many foreigners who go directly home with their catches at the end of the season, and the crude system of control in operation by the authorities.

The following table shows the catch of salmon in the four districts for the year 1898:

District	Spring	Summer	Autumn
Nikolaevsk		7,464,896	4,685,480
Okhotsk	60,000	873,000	2,662,000
Kamchatka	1,067,000	316,950	665,500
Sakhalin	666,000	635,000	748,000
Total	1,793,000	9,289,846	8,760,980

In the Anadir district the catch in 1909 was as follows: Cape St. Michael, 91,616; above Cape Neuman, 8,234; Anadir River, 150,746; Anadir River estuary, 9,864; Hanchelar River, 6,121; Cape Observation, 270,000; total, 536,581. The catch by natives and small Russian fishermen is estimated at about 3,000,000 and 500,000 fish, respectively. In addition to this, 130 barrels of caviar, weighing 14 tons, were prepared, and there were 20 tons from Cape Observation.

According to the statistics of the Fisheries Control, the catch of salmon in the Amur River in 1910 was as follows: Spring salmon, 7,701,344; summer salmon, 21,384,549; autumn salmon, 9,546,254; in all, 38,632,147. Of this number 34,649,025 fish were marketed and the balance consumed locally. Japan bought 23,228,481 fish, valued at $473,800; the balance was valued at $681,345. In addition there were 4,766,784 pounds of salmon caviar, valued at an average price of $0.114 per pound, totaling $543,413, which brings the total value of the salmon catch and by-products up to $1,698,558. During the same year, in Peter the Great Bay, 8,263 salmon were caught.

The number of salmon caught in eastern and western Kamchatka and in the bays and rivers in this region not included in the Russo-Japanese Fishing Convention of 1907, and at the Russian river stations, in 1911, was as follows:

Species	Western Kamchatka	Eastern Kamchatka	River stations	Bays and river outlets	Total
Chavitch (king)	5,421	7,818	207	590	14,036
Keta (chum)	3,082,300	2,675,000	297,300	890,790	6,945,390
Krasnaia (red)	2,136,800	747,000	689,000	236,240	3,809,040
Garbusha (humpback)	39,448,500	1,411,000	1,320,200	175,980	42,355,680
Kishutch (coho)	327,200	179,000	114,200	7,770	628,170
Total	45,000,221	5,019,818	2,420,907	1,311,370	53,752,316

In the Okhotsk district the catch amounted to 827,274 keta and 37,790 krasnaia. Of salmon caviar 489 tons were prepared by the Japanese and 60 tons by the Russians.

In 1915 about 50,000 barrels of pickled salmon were prepared on the Amur River. In the sections covered by the Fishing Convention 6,000,000 salmon, mostly keta with a few krasnaia, were dry-salted, while 80,000,000 humpback salmon, called "salmon trout" in Japan, were so prepared. No fish were frozen for the European market, due to the war. A considerable quantity of caviar was prepared, but the quantity is unknown. The pack of canned salmon is shown elsewhere.

In the "Pacific Fisherman" (February, 1917), Seattle, Wash., its Hakodate (Japan) correspondent reports the following particulars of the 1916 salmon season:

During the year 1916 the salmon catches in the States of Kamchatka and Okhotsk, Siberia, varied greatly according to districts. On the west coast of Kamchatka and Okhotsk there was a big run all season, but the run on the east coast of Kamchatka was extremely poor, except in the Kamchatka River. The distribution of salmon varieties is always limited to about the following districts:

Chums are present in large quantities on the east coast of Kamchatka and Okhotsk, but on the west coast of Kamchatka they are never plentiful.

Red salmon are almost entirely limited to two districts, the Kamchatka and Ozernaya Rivers, being very scarce in other districts.

Humpbacks are found all along the coast, but most especially in the district of Boliskreska [Bolsheryetzk], where there is always a large run.

Silver salmon are found in small quantities on the west and east coasts of Kamchatka at certain seasons of every year.

King salmon are present in very limited quantities, early in the season on the west and east coast of Kamchatka.

There were 17 canneries operated in 1916, and they packed about 470,000 cases. There were 218 fishing places on the shores, and the number of salmon caught during the season was 94,582,228.

All the salmon packers and fishermen in Siberia have used steamers for the transportation of their goods for several years past, but owing to the high rates now prevailing on steamer tonnage they were obliged again to make use of sailing vessels. Prices of all equipment and outfits for the canneries and salting stations were from 30 per cent to 50 per cent higher than for the previous year, but as a result of the strong demand for salmon products due to the European war, all the markets are in good condition. Accordingly, preparations for the coming season are expected to be on a more extensive scale, both as to number and size of canneries and development of the fisheries.

The above statement is accompanied by the following estimate of the number of salmon caught in 1916 in the States of Kamchatka and Okhotsk, except in the rivers:

Species	Okhotsk	East Kamchatka	West Kamchatka	Total
	Number	*Number*	*Number*	*Number*
Chum	1,482,312	2,318,964	1,669,056	5,470,332
Humpback	3,710,320	1,776,112	79,926,512	85,412,944
King		3,276		3,276
Red		308,502	3,311,304	3,619,806
Silver			75,870	75,870
Total	5,192,632	4,406,854	84,982,742	94,582,228

FREEZING SALMON

As when the Russians owned Alaska, the exploitation of Siberia was carried on for many years by trading companies with large powers granted by the Government. In 1892 a very enterprising company was in charge, judging from the following extract from a letter written on February 2, 1893, by the late Eugene G. Blackford, the well-known fish dealer of New York, to the late Col. Marshall McDonald, then United States Commissioner of Fish and Fisheries:

I have just learned of the arrival in Chicago of 60,000 pounds of frozen salmon. They were caught in Petropavlovsk, Kamchatka. These fish are a new venture undertaken by a commercial trading company who control that country, and these salmon have been taken from a river where none have been caught before, and my information is that they catch fish weighing as much as 150 pounds each. The above lot of fish was brought frozen to Tacoma and then shipped by refrigerator car to Chicago, where they were sold to Mr. Booth, of the Booth Packing Co., Chicago. Mr. Booth has declined to pay for them because of their not being in satisfactory condition.

Nothing further appears to have been done in this line until in 1903, when a Berlin fish merchant outfitted and sent to the Siberian coast a refrigerator steamer with a capacity of 2,500 tons. The fish were caught mainly in the Amur River and were frozen immediately after being brought aboard. In all, 160,000 salmon were obtained, and these were in excellent condition when landed at Hamburg, Germany.

In 1907 the Salmon Steam Fishing Co., a combined British and Japanese company, chartered the steamers *Zenobia* and *Zephyrus*. These vessels were fitted with refrigerating apparatus and cold-storage chambers and sent to the Kamchatkan Peninsula to get a cargo. Both secured good cargoes.

In 1909 two refrigerating steamers visited the coast and froze salmon for the European market. One vessel was outfitted by a British company and the other by a German company, J. Lindenberger (Inc.). The latter reported that the chum salmon, the principal species frozen, were large and very bright. The British steamer left England in April and arrived home again late in December.

CANNING SALMON

In 1900 the Kamchatka Commercial & Industrial Co. (Ltd.), was organized at St. Petersburg, Russia, by A. T. Prozoraf, president of the St. Petersburg Chamber of Commerce; P. M. Grunwalt; H. T. M. Court, and A. A. Prozoraf, secretary. A complete canning outfit was purchased in the United States, and the first cannery in Siberia established at Petropavlovsk, Avacha Bay, Kamchatka.

The San Francisco Trade Journal, under date of December 19, 1902, printed the following item relating to the operations of this cannery:

> On December 8 the Russian barkentine *Bitte* arrived from Petropavlovsk, Siberia, with 10,436 cases canned salmon. This is the first consignment of salmon received from them.

The greater part of the pack comprised chum salmon, although they were labeled "pink" salmon, the rest being reds and kings.

In 1903 the company did not operate, the fishing season being devoted to moving the plant to Ust-Kamchatka, at the mouth of the Kamchatka River, where, after being in use altogether for two or three years, it was abandoned.

In 1907 two canneries were established in the estuary of the Amur River, near Nikolaevsk, but beyond getting out samples they were never operated.

In 1910 A. G. Denbigh, an Englishman, built a modern cannery near the second site of the Kamchatkan Commercial & Industrial Co. That year the cannery produced only about 10,000 cases, but each year since the equipment of the plant has been enlarged and improved until in 1913 the pack amounted to 60,000 cases. Early in 1914 a complete two-line plant of American can-packing machinery was installed.

In 1912 Mr. Denbigh built another cannery 1½ miles away from the above plant. This plant was first operated with German and Norwegian sanitary machinery, but in 1914 a two-line American sanitary can-packing plant was installed, the can-making plant at the first plant making all the cans needed at the two canneries.

In 1915 a number of additions were made to both plants in the line of flat fillers, etc., while still more were in contemplation for 1916.

Mr. Denbigh also operated a hand cannery at Kompakova, on the west side of the Kamchatka Peninsula.

Up to 1912 very few canneries, and these very primitive affairs, had been built by the Japanese, owing to the uncertainty of tenure. The "canneries" were mere sheds or shelters where the cans—which were brought from Japan, made or half made—were filled, closed, and cooked, furnace-heated, vertical retorts being used for the latter purpose. If the owner lost his concession at the end of the fishing season he simply took his retorts away with him and the buildings were left to his successor.

In 1912 a Tokyo company (Ichigumi & Co.) put up two canneries near the Ozernaya River in Kamchatka, while a Japanese from Niigata, Japan, also put up a small plant in the same vicinity. Both plants were cheaply built and operated with hand-power machinery and small vertical retorts. That year the two companies together packed about 13,500 cases of salmon.

The same season Ichigumi & Co. put up another hand-power cannery, and Tsutsumi & Co., of Hakodate, Japan, built two others of the same type near the Kamchatka River, on the east coast.

In 1913 Tsutsumi & Co. built a modern cannery at Ozernaya and installed a complete line of American sanitary can-making and can-packing machinery.

The same year Ichigumi & Co. put up two hand-power canneries near the Kamchatka River, having succeeded to the concessions formerly held here by Tsutsumi & Co. In 1914 they built a modern plant and installed a complete line of American sanitary can-making and can-packing machinery.

The St. Petersburg firm of S. Grooshetsky & Co., which has been engaged for a number of years in the freezing of salmon and in the preparation of salmon caviar, under the name of the Pacific Ocean Sea Industry Association, erected a cannery near Ozernaya in 1914, and installed in it a full line of American sanitary can-making and can-packing machinery. This plant will compare favorably with most of our Alaska canneries. The buildings are of iron.

In 1915 a number of extensive improvements in the way of new buildings, machinery, etc., were made to the various plants, and during the winter of 1915–16 several of the canning firms had representatives in this country selecting much additional machinery for use during the 1916 season. During the latter season Tsutsumi & Co. erected a large new plant at Kiseka and a one-line plant above Kiseka. This company also operates a can-making plant at Hakodate, equipped with American Can Co. machinery and with a capacity of 800,000 cans per day. Owing to the heavy demand, caused by the war, a number of small hand-pack canneries also operated.

In 1917 A. G. Denbigh built a cannery at Javino, on the west coast of Kamchatka Peninsula. All the machinery in this plant is electric driven.

In 1918 the ravages occasioned by the war so far as personnel, transportation, tinplate shortage, and market conditions were concerned had come to a head, and as a result the Grooshetsky & Co. and some of the smaller canneries did not operate, while Tsutsumi & Co. operated only those of its canneries which packed red salmon.

In 1919 conditions were much more favorable in Siberia, and as a result the three Russian plants which were shut down in 1918 reopened. Tsutsumi & Co. erected and operated a new cannery in Ust-Kamchatka. The Nichiro Gyogyo Kabushi Kaisha, or Russo-Japanese Fisheries Co. (Ltd.), built and operated two additional one-line canneries at Kompakova and Kiseka.

The following table shows the detailed pack of canned salmon made by the various companies operating in Siberia in 1915:

Siberia canned salmon pack in 1915 [1]

Name and cannery location [2]	Canneries	One-pound flats: Reds	Springs	Silvers	Chums [3]	Humpbacks	Total
		Cases	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*
A. G. Denbigh, Kamchatka River (2) and Kompakova	3	58,000		26,000	38,000		122,000
Food Products Exp. Co	4	[4] 35,000					35,000
S. Grooshetsky & Co., Bolsheryetzk	1	6,000			23,000		29,000
Minard & Co	1				7,000		7,000
Nichiro Fishing Co. (Ltd.), Kamchatka River	1	14,703	3,334	2,191	11,981		32,209
Sugamiya	1	2,200					2,200
Tsutsumi & Co., Ozernaya	1	[5] 37,800			8,800		46,600
Hand-pack canneries, East and West Kamchatka	2	1,000			4,000	10,000	15,000
Total	10	154,703	3,334	28,191	92,781	10,000	289,009

[1] From Pacific Fisherman Yearbook for 1916, p. 44.
[2] There were also a couple of small canneries operated on the Amur River which are not shown here.
[3] Called "Pinks" in Siberia.
[4] Includes 10,000 cases one-half pound flats of 8 dozen each.
[5] Includes 10,800 cases one-half pound flats of 8 dozen each.

In order to show the changes which have occurred since 1915 the detailed pack made by the various companies for 1919 is given.

Siberia canned salmon pack in 1919 [1]

Name	Cannery location	Number of canneries operated	Spring: 1-lb. flats	Red: 1-lb. talls	Red: 1-lb. flats	Red: ½-lb. flats
Grooshetsky, S., & Co	Ozernaya, Bolsheryetzk	2			8,363	
Hakama, S., & Co	Opala	1			7,550	
Hokuyo-Gyogyo Kabushiki Kaisha (Ltd.).	Ust-Kamchatka [2]	2			73,058	
Nichiro Gyogyo Kabushiki Kaisha (Ltd.).	Bolsheryetzk, Opala, and Ust-Kamchatka.	3	1,533		56,877	
Shindo, S., & Co	Narachefsky	1			888	
Suda, K., & Co	Palana R	1			900	
Tsutsumi & Co	Ust-Kamchatka, Ozernaya, Javino, Koshegochinsky, Bolsheryetzk (2) and Kuftoi.	7	3,575	557	112,396	18,266
Yushutsu-Shokuhin Kabushiki Kaisha (Ltd.)	Opala Goluiginsky, Koshegochinsky, Javino.[3]	4			80,832	17,604
Total		21	5,108	557	340,863	35,870

[1] From Pacific Fisherman Yearbook for 1920, p. 86.
[2] Formerly Denbigh canneries at Nerpichr and Seaside.
[3] Javino cannery bought from A. G. Denbigh & Co.

The close of the World War found political conditions in Siberia in a badly demoralized condition, with the coast held for several years by the Japanese. As a result of this most of the Siberian-owned canneries fell into the hands of Japanese operators. Finally the

Soviet and Japanese got together and made a new fisheries agreement—the old one having expired some time before—and as the latter's troops were moved out of Siberia, full control was once more vested in the forces controlling Russia. Since then the Russians have been gradually expanding their interests until to-day they own and control the majority of the salmon canneries.

Siberia pack of canned salmon since the inception of the industry [1]

Year	Canneries operated	Kings	Reds	Silvers	Pinks	Chums	Total
		Cases	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*
1910	1		5, 500	2, 500		2, 000	10, 000
1911	1		15, 000	6, 000		4, 000	25, 000
1912			43, 500	18, 000		16, 000	77, 500
1913			102, 900	7, 000	2, 500	21, 000	133, 400
1914			85, 000	22, 500	2, 000	27, 000	136, 500
1915	10	3, 334	154, 703	28, 191	10, 000	92, 781	289, 009
1916	18		177, 800	50, 000	117, 000	81, 000	425, 800
1917	18	2, 556	275, 212	29, 980	137, 197	66, 056	511, 001
1918	15	2, 027	296, 960	43, 588	15, 177	23, 585	381, 337
1919	21	5, 108	377, 290	106, 364	157, 766	101, 983	748, 511
1920	23	10, 249	361, 539	128, 158	75, 950	19, 875	595, 771
1921		15, 233	433, 243	74, 721	83, 567	98, 729	705, 493
1922	22	332	538, 587	51, 457	103, 614	24, 194	718, 184
1923	13		585, 338	22, 035	66, 869	29, 427	703, 669
1924	18		546, 866	39, 483	190, 571	22, 200	799, 120
1925	16		386, 175	82, 407	104, 551	13, 530	586, 663
1926	20		540, 294	87, 901	307, 558	10, 435	946, 188
1927	17		588, 724	84, 121	138, 589	6, 401	817, 835
1928	29		939, 216	84, 791	439, 609	9, 353	1, 472, 969
Total		38, 839	6, 453, 847	969, 197	1, 952, 518	669, 549	10, 083, 950

[1] From the Pacific Fisherman, annual statistical number, January, 1929, p. 86.

Siberia canned salmon pack, 1919 to 1928 [1]

Name	Cannery location	Canneries operated	Spring		Red				Silver			Pink			Chum		Total cases
			1-lb. flats	½-lb. flats, 8-doz.	1-lb. talls	1-lb. flats	½-lb. flats, 8-doz.	¼-lb. flats, 16-doz.	1-lb. talls	1-lb. flats	½-lb. flats, 8-doz.	1-lb. talls	1-lb. flats	½-lb. flats, 8-doz.	1-lb. flats	½-lb. flats, 8-doz.	
1919																	
Grooshetsky, S., & Co.	Ozernaya, Bolsheryetzk									5,337			20,248				33,948
Hakama, S., & Co.	Opala																7,550
Hokuyo-Gyogyo Kabushiki Kaisha (Ltd.).	Ust-Kamchatka [2]									31,484					78,589		183,131
Nichiro Gyogyo Kabushiki Kaisha (Ltd.).	Bolsheryetzk, Opala, and Ust-Kamchatka.									20,941			12,200		11,018		102,569
Shindo, S., & Co.	Narachefsky									177							1,065
Suda, K., & Co.	Palana R.																900
Tsutsumi & Co.	Ust-Kamchatka, Ozernaya, Javino, Koshegochinsky, Bolsheryetzk (2), and Kuftoi.								17,909	30,516		50,027	60,807		12,376		306,429
Yushutsu-Shokuhin Kabushiki Kaisha (Ltd.).	Opala, Goluiginsky, Koshegochinsky, Javino [3].												14,484				112,920
Total									17,909	88,455		50,027	107,739		101,983		748,512
1920																	
Grooshetsky, S., & Co.	Ozernaya, Bolsheryetzk	2				16,690				5,430			23,845				45,965
Hokuyo-Gyogyo, K. K.	Ust-Kamchatka	2	3,327			59,156				33,253					18,449		114,167
Kamchatka Gyogyo, K. K.	Narachefsky, Opala Bolsheretsk, Worofskoi (2).	5	48			33,356				16,368			2,700				52,472
Nichiro-Gyogyo, K. K.	Bolsheretsk, Opala and Ust-Kamchatka.	3	4,961			43,553				12,837			13,340		1,378		76,069
Suda, K., & Co.	Palana River	1				7,938									48		7,986
Yushutsu Shokuhin, K. K.	Opala, Koshegochinsky (2) Javino (2), Ust.-Kamchatka, Ozernayo (2), Bolsheretsk (2) [3].	10	3,494			148,900				40,723		36,065					281,128
Total		23	11,830			309,593				108,611		36,065	39,885		19,875		577,787
1922																	
EAST COAST																	
Hokuyo-Gyogyo, K. K.	Nerpichr and Seaside	2	204	128		81,084	42,136			35,712					24,086	108	183,458

Nichiro-Gyogyo, K. K.	Kamchatka River and Narachef.	3				15,479	93,125			11,560	248						120,412
Total east coast		5	204	128		96,563	135,261			47,272	248				24,086	108	303,870
WEST COAST																	
Nichiro-Gyogyo, K. K.	Ozernoi, Javino, Koshegotic, Opala, South Bolsheretsk, North Bolsheretsk, and Worofskoi.	11				67,394	238,304			3,937		59,231	15,519				384,385
Grooshetsky, S., & Co.	North Bolsheretsk	1				369						28,587					28,956
Suda & Co.	Palana	1				696											696
Kodama & Co.	Ozernoi	1										277					277
Total west coast		14				68,459	238,304			3,937		88,095	15,519				414,314
1923																	
EAST COAST																	
Nichiro-Gyogyo, K. K.	Narachef	1				908	4,322			926			21				6,180
Taihoku-Gyogyo, K. K.	Kamchatka River	2				166,310	18,579			575	20,534				27,531	1,896	235,425
Total east coast		3				167,218	22,901			1,501	20,534		24		27,531	1,896	241,605
WEST COAST																	
Grooshetsky, S. & Co.	Ozernoi and North Bolsheretsk.	1				43,570							18,797				62,367
Kitaro-Nishino	Palana	2				8,786	2,918										11,704
Nichiro-Gyogyo, K. K.	Ozernoi, Javino, Koshegotic Opala, South Bolsheretsk, North Bolsheretsk, and Worofskoi.	10				242,558	97,387						46,594	1,451			387,993
Total west coast		13				294,914	100,305						65,391	1,454			462,064
Grand total		16				462,132	123,206			1,501	20,534		65,415	1,451	27,531	1,896	703,669
1924																	
EAST COAST																	
Nichiro-Gyogyo, K. K.	Narachef	1				985	64						191	796			2,036
Taihoku-Gyogyo, K. K.	Ust-Kamchatka	3				183,978	18,825			39,143					22,200		261,146
Total east coast		4				184,963	18,889			39,143			191	796	22,200		266,182

[1] A list of the individual operators could not be obtained for 1921 but the pack follows: King, 15,233 cases; red, 433,243; silver, 74,721; pink, 83,567; and chum, 98,729.
[2] Formerly Denbigh Canneries at Nerpichr and Seaside.
[3] Javino Cannery bought from A. G. Denbigh & Co

Siberia canned salmon pack, 1919 to 1928—Continued

Name	Cannery location	Canneries operated	Spring: 1-lb. flats	Spring: ½-lb flats, 8-doz.	Red: 1-lb. talls	Red: 1-lb. flats	Red: ½-lb. flats 8-doz.	Red: ¼-lb. flats, 16-doz.	Silver: 1-lb. talls	Silver: 1-lb. flats	Silver: ½-lb. flats, 8-doz.	Pink: 1-lb. talls	Pink: 1-lb. flats	Pink: ½-lb. flats, 8-doz.	Chum: 1-lb. flats	Chum: ½-lb. flats, 8-doz.	Total cases
WEST COAST																	
Grooshetsky, S. & Co.	Ozernoi	1				24,159											24,159
Kitaro Nishino	Palana	1				10,290	1,068										11,358
Nichiro-Gyogyo, K. K.	Ozernoi, Javino, Koshegotic, Opala, South Bolsheretsk, North Bolsheretsk, Kefta, and Worofskoi.	11				258,924	48,573				340		188,776	38			496,651
Total west coast		13				293,373	49,641				340		188,776	38			532,168
North Saghalien: Keinojyo Sato.	Nanaisky	1											770				770
Grand total		18				478,336	68,530			39,143	340		189,737	834	22,200		799,120
1925																	
EAST COAST																	
Nichiro-Gyogyo-Kaisha (Ltd.).	Narachef	3				40,887	148,488			48,367	26,852				12,129		276,723
WEST COAST																	
Nichiro-Gyogyo-Kaisha (Ltd.).	Ozernoi	1					59,974										59,974
	Yavina	2					63,139										63,139
	Koshegotic	1					32,622				79						32,701
	Opala	1					17,240							808			18,048
	South Bolsheretsk	2				16,606	426				284		6,168	107			23,591
	North Bolsheretsk	1				1,030	1,050				1,064		7,812	584			11,540
	Puirnta	1								1,225		977	21,814				24,016
	Kefta	1				542				1,069			18,181				19,792
	Worofskoi	2				2,303				3,467			48,100				53,870
Total Nichiro-Gyogyo-Kaisha pack (east and west coasts).		15				61,368	322,939			54,128	28,279	977	102,075	1,499	12,129		583,394

Kichitaro-Nishino	Palana	1				1,368									1,401		3,269
Total west coast		13				22,349	174,451			5,761	1,427	977	102,075	1,499	1,401		309,910
Grand total		16				63,236	322,939			54,128	28,279	977	102,075	1,499	13,530		586,633
1926																	
EAST COAST																	
Nichiro-Gyogyo-Kaisha (Ltd.).	Narachef and Kamchatka River.	3				116,556	185,765			39,670	36,269				10,435		388,695
WEST COAST																	
Nichiro-Gyogyo	Ozernoi	1					65,776							7,224			73,000
Kaisha (Ltd.)	Yavina	2					69,585							7,145			76,730
	Koshegotic	1					31,980							13,058			45,038
	Opala	1					22,837							13,389			36,226
	South Bolsheretsk	2					14,281							35,945			50,226
	North Bolsheretsk	1				3,684	1,060			811	2,269		45,430				53,254
	Puimta	1				929				245		1,014	43,727				45,915
	Kefta	1				1,096				350			25,050				26,496
	Worofskoi	2				10,684	1,030			1,736	1,065		90,891				105,406
Total Nichiro-Gyogyo-Kaisha (east and west coasts).		15				132,949	392,314			42,812	39,603	1,014	205,098	76,761	10,435		900,986
Lyuri & Co.	Kuikchik [4]	1					581			401	4,247		19,500	396			25,125
M. V. Chulyu Kin	Obrukovina [4]	1								330	416		2,235	1,007			3,988
H. Yashima	Yicha [4]	1				95				92			1,510				1,697
Matsuda Shoji & Co.	Palana	1				14,355											14,355
S. Saito	Muhina [4]	1											37				37
Total west coast		17				30,843	207,130			3,965	7,997	1,014	228,380	78,164			557,493
Grand total		20				147,399	392,895			43,635	44,266	1,014	228,380	78,164	10,435		946,188
1927																	
EAST COAST																	
Nichiro-Gyogyo-Kaisha (Ltd.).	Narachef and Kamchatka River.	3				105,313	184,933			4,034	24,478				3,317		322,075
AKO [5]	Kamchatka River	1				19,400	41,148			10,828	10,876				4,100		86,352
Total east coast		4				124,713	226,081			14,862	35,354				7,417		408,427

[4] New cannery.

[5] Known during the packing season as Dalgostybtrust, formerly "Okaro"; a Russian "State trust."

Siberia canned salmon pack, 1919 to 1928—Continued

Name	Cannery location	Canneries operated	Spring		Red				Silver			Pink			Chum		Total cases
			1-lb. flats	½-lb. flats, 8-doz.	1-lb. talls	1-lb. flats	½-lb. flats, 8-doz.	¼-lb. flats, 16-doz.	1-lb. talls	1-lb. flats	½-lb. flats, 8-doz.	1-lb. talls	1-lb. flats	½-lb. flats, 8-doz.	1-lb. flats	½-lb. flats, 8-doz.	
WEST COAST																	
Nichiro-Gyogyo-Kaisha	Ozernoi	1					29,941							533			30,474
	Yavina	2					51,937							757			52,694
	Koshegotik	1					44,875				13			259			45,147
	Opala	1					35,324				213			2,771	606		38,914
	South Bolsheretsk	2					38,469				728			4,477		205	43,879
	North Bolsheretsk	1			2,418	6,272	287			4,676		17,866	1,733				33,252
	Puimta	1				2,583				3,278		31,298			787		37,946
	Kefta	1				962				1,267			25,205		399		27,833
	South Worofski	1				2,233				4,010			19,597		741		26,581
	North Worofski	1				2,306				2,502			18,642		346		23,796
	Kolpakofsky	1					2,231				9,545			6,628			18,404
	Sopochinaya	1					236				763						999
Total Nichiro-Gyogyo-Kaisha pack (east and west coasts).		17			2,418	119,669	388,233			19,767	35,740	49,164	65,177	15,425	6,196	205	701,994
Hatakeyama & Co	South Bolsheretsk	1					3,800						1,000				4,800
Lyuri & Co	Kuikchik	1					7,300			1,577	1,965			3,723			14,565
	Palana	1				2,000	3,500										5,500
Matsuda Shoji (Ltd.)	do	1				880	2,094										2,974
Taiyo-Gyogyo-Kaisha (Ltd.)	Yavina (floating)[4]	2					700										700
Yashima, H	Yicha	1									950						950
Total west coast		21			2,418	17,236	220,694			17,310	14,177	49,164	66,177	19,148	2,879	205	409,408
Grand total		25			2,418	141,949	446,775			32,172	49,531	49,164	66,177	19,148	10,296	205	817,835

1928																	
EAST COAST																	
AKO (Kamchatka Co. (Ltd.)).	Kamchatka River No. 1	1				38, 115	30, 141			7, 520	33, 790					4, 445	114, 020
	Kamchatka River No. 2 [4]	1				1, 667	20, 698				3, 046					3, 500	28, 911
Nichiro-Gyogyo-Kaisha (Ltd.).	Narachef and Kamchatka River.	3				158, 362	165, 602			9, 093	16, 850						349, 907
Total east coast		5				198, 144	216, 441			16, 613	53, 695					7, 945	492, 838
WEST COAST																	
Nichiro-Gyogyo-Kaisha (Ltd.).	Ozernoi	1					81, 518							4, 239			85, 757
	Yavina	2				41, 603	52, 020							5, 492			99, 115
	Kochegochik	1				43, 846	13, 732							3, 797			61, 375
	Opala	1				21, 651	69, 387	13, 072									104, 110
	South Bolsheretsk	2				9, 968	58, 399							679		910	69, 956
	North Bolsheretsk	1				4, 220				1, 738		50, 492	10, 245		498		67, 193
	Puimta	1			33		1, 448	2, 013			949	48, 686	917				54, 046
	Utka [4]	1			364		1, 408	965		139	1, 017	42, 106					45, 999
	Kefta	1				1, 496				281			46, 907				48, 684
	Worofskoi	2				7, 809				1, 377			96, 981				106, 167
	South Kolpakova	1					4, 904				426			21, 516			26, 846
	North Kolpakova	1				2, 885				159			43, 623				46, 667
	Sopochinaya	1					1, 392				494						1, 886
Total Nichiro-Gyogyo-Kaisha pack east-west coasts.		19			397	291, 840	449, 810	16, 050		12, 787	19, 736	141, 284	198, 673	35, 723	498	910	1, 167, 708
AKO (Kamchatka Co. (Ltd.)).	Ozernaia River [4]	1				19, 132	11, 178						250				30, 560
Hatakeyama & Co.	South Bolsheretsk	1				1, 290	4, 470						120	4, 200			10, 080
Hayashikane Shoten (Ltd.)	Krutogorowa [4]	1				434	418						15, 148	706			16, 706
Lyuri & Co. (Ltd.)	Kuikchik	1				1, 779	923			4, 364	1, 920	14, 494	15, 086	2, 051			40, 617
Do.	Palana	1				11, 996	1, 759										13, 755
Nishino & Co.	do.	1				10, 900		5, 200									16, 100
Ogawa Gomei	South Bolsheretsk	1				17, 889	2, 510				1, 205	5, 109	2, 508	2, 914			32, 135
Yashima, H.	Yicha	1					620			414				1, 343			2, 377
Total west coast		24			397	196, 898	306, 086	21, 250		8, 472	6, 011	160, 887	231, 785	46, 937	498	910	980, 131
Grand total		29			397	395, 042	522, 527	21, 250		25, 085	59, 706	160, 887	231, 785	46, 937	498	8, 855	1, 472, 969

[4] New cannery.

SALTING SALMON

By far the greater part of the salmon catch of Siberia is either pickled or dry salted. This was the earliest commercial method initiated on the coast and has been followed for a number of years, mainly by the Japanese. The coast is dotted with concessions worked by Japanese, while there are large numbers in operation along the rivers, these being restricted to Russians. An idea of the extent of this branch of the industry may be gathered when it is stated that in 1915 there were 50,000 barrels of pickled salmon prepared in the Amur region, while the Japanese dry salted about 6,000,000 chum salmon, including also a few reds, and 80,000,000 humpbacks, or "salmon trout," as they are called in Japan.

In pickling salmon the fish are split down the back, the sides being held together by the belly. The roe, gills, and viscera are removed and the fish are then washed, and after salting are placed in large tanks for seven or more days, or until they are thoroughly struck, after which they are packed in barrels, flesh side up, except the two top layers, which have the skin side up. To about 700 pounds of fish 180 pounds of salt are used.

The dry salting, next to drying, is the most primitive method employed in preserving salmon. The process consists simply in splitting the fish up the belly, removing the gills and entrails, and then filling the belly with salt. The fish are then placed in rows on matting and covered with salt, and other rows are placed on top of them until the pile is from 8 to 10 feet high, when the entire lot is covered with matting and left for about seven days, after which they are relaid and again covered with salt. For shipping, the fish are packed in mats.

A very odd feature in connection with the operation of most of the Japanese plants is that the salt to be used in curing the fish is usually dumped loose onto some level spot, with absolutely no covering over it and exposed to the elements.

The Japanese consume enormous quantities of these dry-salted salmon. During the Russian-Japanese war the latter country's fishermen were cut off from access to their usual fishing grounds, with the result that they were forced to look elsewhere for fish. During 1905 and 1906 large quantities were prepared in Alaska, British Columbia, and Washington for this trade, but as soon as the war ended and the Japanese got access once more to their old fishing grounds, the Japanese duty on salt fish, which had been suspended during and for a short period after the war, was reimposed. As a result our fishermen soon quit the business, and since then operations on this coast have been almost wholly restricted to Japanese operating in British Columbia waters.

At the height of the production on this coast Mr. King, the American consular agent at Hakodate, Japan, made the following suggestions to preparers and shippers of dry-salted salmon for the Japanese trade:

> The salmon should arrive in Japan by December 1. Most of these fish are used among the Japanese for New Year's presents. After the new year the price invariably declines 20 to 30 per cent, and for a month or two the fish are difficult to dispose of, as the consumers always stock up before the new year.
>
> The salmon should weigh not less than 5 pounds when thoroughly cured. They should be free from spots, which are usually found on the salmon if caught in fresh

or brackish water. No Japanese would think of giving a salmon with red and black spots to a friend for a New Year's present, and spotted fish never realize more than half the price obtainable for clean white fish. The salmon should be split up the belly and should be salted with fine salt. Coarse salt always tears the flesh of the fish when being rubbed in. Care should be taken that the salmon are not oversalted.

Semga salting is a more improved and sanitary method than that of straight pickling and is used when the fish are being prepared for the European market. Selected fish are cut open along the belly and the viscera and gills are carefully removed. In order that the salt may penetrate the flesh more thoroughly, the flesh on the inside is scored several times. The fish are then carefully washed and rubbed with brushes, after which they are kept on ice for 24 hours. The brine is carefully prepared and very strong. When properly struck the fish are repacked into barrels.

"Kolodka" is a very crude and cheap method of salting. The fish are half salted and half dried without being cut open, and are sold at the place where prepared.

The natives prepare a great many salmon for the winter use of themselves and their dogs, the same as do the Alaskan natives. The fish are dried without the use of salt. The product is known as "youkala."

Some salmon bellies are also cut out and salted, although this has never attained to prominence.

Some fresh salmon, as well as salted, are smoked for local consumption.

Barrels, or tierces, for packing salmon are made from cedar, larch, or fir, with a net capacity of 900 to 1,000 pounds of fish, and are bound with wooden and iron hoops.

THE SALMON FISHERIES OF JAPAN

Outside of Karafuto (that portion of Sakhalin Island, south of 50° north latitude, which belongs to Japan) and the Kuril Islands, the salmon fisheries of Japan are comparatively small, the principal portion of the immense catches made by Japanese fishermen being along the coasts of Siberia and Karafuto.

All of the five species of salmon found on the American side are to be found in the waters of Sakhalin during the usual spawning periods.

The chum salmon (*O. keta*), which is known in Japan as "sake," and when canned as "pink" salmon, is to be found on Hokushu Island, running up the various streams for spawning purposes from September to December.

On the same island is to be found also the masu (*O. masou*), a salmon, according to Doctor Jordan,[44] very similar to the humpback, the scales being a little larger, the caudal fin without black spots, and the back usually immaculate. It is fairly abundant in the streams of Kokushu, the island formerly known as Yezo, and is found nowhere else in the world. The author had an opportunity to examine a dry-salted masu (it might be well to state here that in Japanese masu means "trout") at the fish house of the Royal Fish Co., in Vancouver, British Columbia, in January, 1916. The manager, Mr. Emy, had imported the fish from his own country. Both in

[44] Fishes, p. 296. By David Starr Jordan. New York, 1907.

size and general appearance it closely resembled a humpback salmon, and when cut open the flesh had the same coloring observable in our humpback. This species, and the true humpback found in more northern waters, especially in Siberia, are dry salted in immense numbers and are generally marketed under the name of "white trout" or "salmon trout."

In Japan the "red trout" seem to be our rainbow and brook trouts, which were introduced into Japanese waters some years ago. The red salmon (*O. nerka*) is to be found landlocked in Lake Akan in the northern part of the island. It is smaller in size than the sea species. This species has been introduced into the waters of Honshu.

The section of this report devoted to the salmon fisheries of Siberia treats quite fully of the activities of the Japanese in that quarter.

In Sakhalin, or Karafuto, as it is called in Japan, the Japanese have had a rather checkered career. At one time this island belonged to the Chinese Empire. Early in the nineteenth century the southern portion was occupied by the Japanese. In 1875 she bartered it to Russia in exchange for some small islands in the Kuril group. As a result of the Russo-Japanese war the southern half, or all that portion south of 50° north latitude, was in 1905 ceded to Japan.

The salmon fisheries of this island are of much importance. For many years the Japanese had a virtual monopoly of them, but very early in the present century the Russians attempted to restrict considerably the activities of the Japanese fishermen, and encouraged her own subjects to compete with them. Many hundreds of Russians and Koreans were encouraged to migrate to the island and engage in its fisheries. Despite these handicaps, the operations of the Japanese fishermen, according to the statistics shown below, do not seem to have suffered.

Year	Salmon [1]	Spring salmon	Total	Year	Salmon [1]	Spring salmon	Total
	Koku [2]	*Koku* [2]	*Koku* [2]		*Koku* [2]	*Koku* [2]	*Koku* [2]
1897	8,589	34,246	42,835	1900	7,719	8,797	16,516
1898	6,335	11,228	17,563	1901	3,089	12,735	15,824
1899	8,379	22,959	31,338	1902			24,726

[1] Species not specified.
[2] Koku equals about 5½ bushels.

Considerable fishing is carried on around the island of Yetorofu, one of the Kuril group. Here are found red (*O. nerka*), silver (*O. kisutch*), and chum salmon (*O. keta*), also either the humpback or Doctor Jordan's masu.

CANNING INDUSTRY

The salmon canning industry in Japan proper was inaugurated by the Hokushu Colonization Department, a local branch of the Federal Government. For some time this department had operated a fishery school on Hokushu Island, at which experimental work in the canning of salmon and other fishery products was carried on. This establishment canned considerable salmon during the Russo-Japanese War.

This same department also established a fishery school on Yetorofu Island, one of the Kuril group, which was, in 1908, taken over by Suhara Kakubei, a fisherman and graduate of the school, and used as a salmon cannery.

Some years earlier, however, about 1892 or 1893, Fujino Shirobei started canneries in Shibetsu and Bekkai, Nemuro Province, Hokushu Island, and a short time later Idzumi Shozo also started a plant at Nemuro. For a number of years these three canneries were the only producers. The plants were quite primitive, the product small, and most of it was consumed by the Japanese navy. A demand for the product was gradually worked up, however, and as a result there are now a number of small canning plants on Hokushu Island proper, the Kuril Islands, and Japanese Sakhalin. Most of these plants devote the major part of their energies to the packing of crab meat, the canning of salmon being in most cases a side issue. A few of the plants have been equipped with machinery, but the large majority are hand-pack plants, employing but a few persons.

Most of these plants pack what is called "white trout," which is really the humpback or masu salmon. In 1912 there were in Hokushu and adjacent islands 21 canneries which packed 730 cases (48 one-pound flat cans each) of red (*O. nerka*) and 72,770 cases (48 one-pound cans each) of "white trout," a total of 73,500 cases.

On the Japanese portion of Sakhalin Island 4 canneries packed 10,120 cases (48 one-pound cans each) of "white trout" in 1912.

The pack of canned salmon in Japanese territory in recent years has been as follows:

Year	Hokkaido and Kurils	Karafuto (Japanese Sakhalin)	Total	Year	Hokkaido and Kurils	Karafuto (Japanese Sakhalin)	Total
	Cases	*Cases*	*Cases*		*Cases*	*Cases*	*Cases*
1912	73, 500	10, 120	83, 620	1919	50, 500	18, 000	[1] 68, 500
1913	46, 000		46, 000	1920	18, 500	6, 500	25, 000
1914	50, 450	15, 000	65, 450	1924 [2]			10, 000
1915	55, 000	15, 000	70, 000	1925			90, 000
1916	37, 800	1, 800	39, 600	1926	25, 000	1, 500	26, 500
1917	39, 545	16, 607	56, 152	1927			132, 000
1918	21, 490	5, 000	26, 490	1928	37, 000	10, 000	[3] 203, 100

[1] Composed of 2,500 cases of 1-pound flat red salmon and 66,000 cases of 1-pound flat chum salmon.
[2] No figures given from 1921 to 1923, inclusive.
[3] Includes 156,100 cases of humpback salmon brought to Aomori from Siberia in refrigerator vessels and then canned.

The following table shows the quantities and value of salmon and trout taken by the Japanese fishermen in certain years:

Year	Salmon		Trout	
	Pounds	Yen	Pounds	Yen
1902	5, 722, 475	454, 662	923, 025	121, 499
1907	9, 286, 267	892, 879	4, 500, 008	332, 316
1912	26, 438, 017	1, 594, 230	44, 038, 383	928, 513

FISHERY METHODS

In Japanese waters salmon are taken by means of trap nets, haul seines, and gill nets.

The haul seines used along the seashore have a length of about 500 fathoms. Each is carried by a boat of 9 feet beam with 30 men, and the right wing, called the "outing wing," is first paid out as the boat heads out from the beach. When the pocket, or bunt, is cast the boat turns its course toward the right and steers gradually landward, casting the left wing. When the school is encircled the seine is hauled ashore by the seine ropes.

The floating trap net used for salmon is known as "kaku-ami," or square trap net. This consists of a main net and lead. The main net, or heart, is 70 fathoms long, 10 fathoms wide, and 10 fathoms deep, and the lead is 120 fathoms long. The latter guides the fish toward the main net. When being fished the pot is hauled up by a boat crew and the fish transferred to the boat by means of a dip net.

FISH CULTURE

The artificial culture of salmon is carried on in 56 hatcheries, which are distributed in Hokkaido and the prefectures of Aomori, Akita, Yamagata, Niigata, Toyama, Kyoto, Iwate, and Miyagi. Nine of these belong to the government of Hokkaido and other prefectures, while the rest are owned by fishing associations, individuals, or corporations. The number of young salmon distributed by these hatcheries amounts to over 80,000,000 a year.

The largest hatchery is the one at Chitose, under the supervision of the Hokkaido Fishery Experimental Station. It was established in 1887, and it is estimated that the fish distributed by it number from 20,000,000 to 30,000,000 yearly.

The salmon hatchery of Murakami, Niigata prefecture, dates as far back as 1881, when a regulation pertaining to the preservation of young salmon in the River Miomote was enacted by the prefecture of Niigata. This was first called the "Murakami Salmon Raising Plant," but in 1891 it was turned into a hatchery, and is now distributing 2,000,000 young salmon a year. The salmon hatchery of Nitta River, Fukushima prefecture, is very similar in its history and organization to the above.

The industry has during the last few years become very popular in Yamagata prefecture, where 22 hatcheries are in operation as private enterprises.

In the prefectures of Shiga, Miye, Shizuoka, Nagano, Yamanashi, Kanagawa, Akita, Niigata, Hyogo, Miyazaki, and Hokkaido, the masu (*O. masou*) and the landlocked hime-masu (*O. nerka*) are raised and distributed in the lakes and rivers. There are eight hatcheries working on these species. The hatchery of Lake Towada, Akita prefecture, first transplanted hime-masu from Hokkaido in 1902, and it is now hatching from 5,000,000 to 10,000,000 eggs a year for the purpose of distributing the fish among the different districts.

FISHERY INDUSTRIES OF THE UNITED STATES, 1929 [1]

By R. H. Fiedler

Chief, Division of Fishery Industries

CONTENTS

[1] Appendix XIV to the Report of the U. S. Commissioner of Fisheries for 1930, Bureau of Fisheries Document No. 1095. Submitted for publication June 30, 1930.

FOREWORD

This report constitutes a yearbook on fishery statistics of the United States as well as a summary of activities of the division of fishery industries. As its name indicates, this division of the bureau is concerned with the activities and welfare of the fishery industries, including the commercial fisheries, the trade in fishery products, and the fish canning and preserving industries. Its functions are the collection and publication of fishery statistics, the prosecution of research designed to solve the technical problems of the industry, and the dissemination of authoritative and practical information to the fishery industries and the public. Results of technological investigations and marketing studies are published in separate documents as each project is completed. The information obtained from statistical surveys is published in Part 2 of this report, which includes all the detailed statistical information that has become available since the issuance of the previous report,[2] together with such summarized statements and interpretations of the statistics as are deemed significant and useful. In the preparation of this report numerous members of the division's staff have taken part, and their assistance is appreciatively acknowledged.

Part 1. OPERATIONS OF THE DIVISION

COLLECTION OF STATISTICS

The statistical work of the division in 1929, as in former years, included the collection and dissemination of statistics on the catch of fishery products and the gear employed in making the catch and statistics of related fishery industries. In the former group are those statistics that are intended primarily for the use of the fishery biologist, upon which to base wise conservation measures, although they are indirectly valuable for economic purposes. This is especially true of statistics for the landings of fish at principal fishing ports, which are published monthly. In the latter group are statistics that are of use mainly for economic or trade purposes. In this group are included statistics of the canned fishery products and by-products of the United States, cold-storage holdings of fish and amounts of fish frozen in the United States, marine-animal oil production, and similar statistics.

During 1929 rapid progress was made in the collection of statistics of the catch of fishery products in the United States. This has been occasioned by greater cooperation with State fishery agencies and by the extended use of automobiles by agents, which has enabled them to canvass a larger territory than was formerly the case when travel was performed mainly by train. As a result, catch statistics for 1928 were obtained of the fisheries in our New England, South Atlantic, Gulf, Pacific Coast, and Great Lakes States. Continuous annual catch statistics are now available for the Great Lakes States from 1913, Pacific Coast States from 1922, South Atlantic and Gulf States from 1927, New England States starting with 1928 (as it is now planned to canvass the latter States annually), and the State of Connecticut

[2] Fishery Industries of the United States, 1928. By R. H. Fiedler, Appendix IX to the Report of the U. S. Commissioner of Fisheries for 1929, pp. 401-625. Bureau of Fisheries Document No. 1067.

from 1924. The latest catch statistics now available on each geographical section are as follows: New England, South Atlantic, Gulf, Pacific Coast, and Great Lakes States, 1928; Middle Atlantic States, 1926; Chesapeake Bay States, 1925; and Mississippi River and tributaries, 1922.

In addition to the general catch statistics, the collection and (or) publication of statistics on special subjects was continued during 1929, as follows: The landings of fish by American fishing vessels at the ports of Boston and Gloucester, Mass., Portland, Me., and Seattle, Wash.; landings of halibut at North Pacific coast ports (published monthly, and annual bulletins summarizing these landings for the year); catch of mackerel in the North Atlantic fishery; cold-storage holdings of frozen and cured fish and amount of fish frozen, which are furnished by the Bureau of Agricultural Economics (published monthly); production, consumption, and holdings of marine-animal oils of the United States and Alaska (published quarterly by the Bureau of the Census); production of canned fishery products and by-products of the United States and Alaska during 1929; the catch of shad in the Potomac and Hudson Rivers; the catch of alewives in the Potomac River during 1929; transactions on the sponge exchange at Tarpon Springs, Fla., during 1929; volume of fishery products handled at the municipal fish wharf and market, Washington, D. C., during 1929; and the volume of United States imports and exports of fishery products during 1929, furnished by the Bureau of Foreign and Domestic Commerce.

CATCH ANALYSIS—COLUMBIA RIVER CHINOOK SALMON FISHERY

An investigation was initiated by the bureau during the summer of 1929 for the purpose of determining the relative abundance of chinook salmon in the Columbia River over as long a period of time as might be possible. The method used in attacking the problem consisted of making an analysis of the detailed catch records of this fishery in order to determine the average catch return per constant unit of effort and gear in each year represented in the available data.

With this objective in mind, detailed records of the daily catches of individual fishermen delivered at Astoria, St. Helens, Clifton, and Warrendale—all in the State of Oregon—were collected and tabulated. The catches of the gill-net fishermen appeared to offer the best and most accurate data and were used exclusively in this analysis. The collection of these records was made possible through the cooperation of the Oregon Fish Commission, the Washington Department of Fisheries and Game, and several of the packing companies on the Columbia River. The records from Astoria covered the period from 1909 to 1929, inclusive, and those from Warrendale, Clifton, and St. Helens, 1923 to 1928, inclusive. The average daily landing per fisherman for each day and at each locality included in these data was computed. Since these fishermen are always near a buying station, cannery, or buyer's boat, the daily landings are, in practically all cases, the result of one day's fishing and were so considered

From these data and daily averages, several types of indices of abundance were computed for each group of data and it was found that according to the Astoria data from 1909 to 1925, the trend of the average catch return per unit of effort and gear was without any pronounced increase or decrease. Since 1925, however, there has been a steady decline from 196 pounds average catch per man per fishing day to 102 pounds average catch per man per fishing day during 1929.

It has been possible to determine through a study of the number of licenses issued on the Columbia River, by both of the States of Washington and Oregon, that the amount of gear fishing on that river has been comparatively constant during the period of time from 1909 to 1929, inclusive. This obviates the possible error that might have been caused if the amount of gear on the river had increased or decreased greatly during the last few years and so caused a drop or rise on catch per unit of effort and gear due to increased or decreased competition between pieces of gear.

From tagging and other biological studies it is known that the salmon population spawning in the Columbia River system is composed of numerous separate races or "runs," each of which has its individual parent tributary stream or spawning area, and a fairly constant time for making its annual upstream migration. With these facts already determined it appears that it may be possible by a study of the detailed data to learn something of the fluctuations in abundance of the separate runs, rate of upstream migration, and at what time populations bound for certain tributaries pass through the commercial fishery.

In order to make the results of this investigation conclusive and to guard against possible errors, it is planned to collect more data during the summer of 1930 to establish the adequacy of the present method for sampling the catch records.

TECHNOLOGICAL INVESTIGATIONS

Applied fisheries technology has given the fisheries industries a new outlook on the future. In the three or four decades preceding the World War, little was done to improve conditions in the fisheries with the result that they were fast losing ground. However, under the war's stimulus for more protein food and cheaper methods of manufacture, the fisheries industries learned that to compete with other food industries radical changes were necessary. Realizing this, several agencies set about to study the problems, foremost of which were the Bureau of Fisheries and the College of Fisheries at the University of Washington in Seattle, Wash. These agencies instituted fishery products laboratories where technological studies were made of our fish manufacturing industries. During the interim from war times to the present the industry has applied the results of experiments conducted in these laboratories to commercial procedure, as well as those obtained from research in private fisheries products laboratories more recently established by various fishing companies, and the industry forged ahead in a revolutionary fashion. As a result, excessive overhead expense in the production and manufacture of fishery products has been reduced; a larger number of inland consumers have been supplied with fresh and frozen fishery products, especially those marketed in attractive unit packages of uniform quality; by-products, which formerly were utilized for fertilizer or in the arts and industries, are now used for feedstuffs and, in addition, the rôle of fishery products in the dietary of man has been demonstrated; waste products of the fisheries have been converted into valuable articles of commerce; better methods have been evolved for the manufacture of certain cured and canned fishery products; and preservatives have been developed which prolong the life of fishing nets. All this has stabilized the fishery industries, and the strides made have been so rapid that certain other food industries are looking toward them for guidance, especially those manufacturing frozen food products.

During the past year the division's technologists have been conducting research mainly on problems relating to the manufacture of fish meal and oil, the feeding value of marine products, the handling and transportation of fresh and frozen fish, and the preservation of nets. These problems have carried the technologists to many parts of the country where conditions are studied first-hand. The Reedville laboratory was kept open all the year, due to the fact that problems in the menhaden industry were involved and required continuous study. In addition, a summer laboratory was established at Erie, Pa., to study net preservatives, and a temporary laboratory was in operation at Columbia, S. C., to study the precooling of fish in the South. During the school year the bureau had an employee at Johns Hopkins University, studying the nutritive value of fishery products in cooperation with the nutritional authorities there.

NET PRESERVATION

Development of net preservatives under conditions which accelerate deterioration has been continued at Beaufort, N. C., but special attention has been given to investigation as far as possible of preservative material upon twine exposed in actual fishing waters. The work has been concentrated upon trap and gill nets, since the preventable losses from deterioration of these types of gear represent a considerable amount each year.

TRAP NETS

The service of trap nets differs from that of all other classes of gear for the reason that part of the fabric is in the water for long periods of time. The webbing is hung upon stakes so that the top portion of the net is above high water and the remainder of the net is under water. Thus part of the net is continually under water and hence may foul badly—the character and extent of growth being dependent upon individual localities.

In certain localities and especially on the coast of New Jersey, the growth of marine grasses upon trap nets is very serious, due to the formation of a solid wall which resists water movement and by which action the net may be washed out in a storm. Shell growths such as barnacles attach to the net and are objectionable as they may injure the hands of the fishermen when the net is fished. All fouling adds to the weight of the net and hence to the labor of fishing.

Too little attention has been given to the necessity in trap-net preservatives of a coating on the twine that will offer increased resistance to mechanical abrasion. Certain portions of a trap net are subjected to severe wear when webbing is hauled over the gunwale of a boat; the wave action, especially in storms, subjects portions of the net to abrasion against the stakes and the damage from driftwood is of no small consequence.

Recognizing that knowledge of the effect of preservatives in actual fishing waters is essential for practical developments, various methods have been employed which would serve for test purposes; due to personal factors, this phase of investigation has not been altogether successful, but in the past season reasonably satisfactory tests were obtained in fishing waters by mailing to cooperators, light wooden frames containing twines covered with experimental preservatives, the frames after a certain exposure being returned to Washington for a test. While the number of preservatives tested by this method is limited, the extension of knowledge of deterioration in various waters is of great value.

Experiments have demonstrated that among the best preservatives for trap nets are cuprous oxide, coal tar, mercuric oxide, and copper oleate. The proportions of these incorporated into the net appear to depend upon individual localities. Coal tar is more effective in salt water than in fresh water and also where tidal action is above normal. Cuprous oxide and copper oleate are most effective in quiet and in fresh water. Under certain conditions, mercuric oxide is an excellent preservative when used with coal tar; its cost is high and hence it should be used only when necessary. More complete information relative to the preservation of trap nets is contained in Fisheries Document No. 1075.

GILL NETS

The study of the problem of obtaining longer service from gill nets by the use of preservatives has been continued, and it has been demonstrated that the use of the soluble portions of coal tar carrying fine cuprous oxide has increased the life of the net up to 40 per cent. A mixture of copper oleate and copper resinate has also proved efficacious. The former treatment produces a brown net and the latter treatment a greenish net. The fishing power of the colored nets appears to be equal to that of plain or untreated material.

No preservative will prevent the damage to gill nets that is caused by snags or by the present method of removing fish, although a sustained mechanical strength, through the use of preservatives, should lessen losses from these causes. Fishermen recognize that gill nets should be thoroughly washed after use, but greater care should be used in storage after drying. Direct sunlight is a powerful chemical agent, and a gill net should be stored away from direct sunshine as soon as possible after drying. The deterioration of gill nets under certain local water or atmospheric conditions is extremely rapid and can not be explained by the present methods of washing and drying which are reasonably constant. It would appear that prevention of rotting by the use of preservatives is essential and may be accomplished when the causes of the rotting are better understood. Further information concerning the preservation of gill nets is contained in the document referred to above.

BY-PRODUCTS

MENHADEN

During the past year the bureau continued its technological study of the menhaden industry. This industry has been given special attention since it is typically representative of most of the oily fish reduction industries, and certain of the information obtained should find application in all by-products industries where similar materials are handled and the wet process of reduction is considered most advisable. In addition, the menhaden industry is perhaps in most need of assistance because of the recent decrease in the annual amount of raw material taken. For instance, in 1922 the peak catch amounted to 1,212,450,669 fish while in 1929 the catch barely exceeded 660,000,000 fish. The factories representing the industry were designed and first operated during periods of bountiful fishing. With an abundant supply of fish on hand, little attention was given to the efficiency of the process. Now, however, the same factories must operate on smaller quantities of fish and losses formerly unnoticed are becoming of considerable economic importance. If by technical improvements in the process used the losses now encountered could be reduced, the amount of material obtained from the supply of raw material at hand would necessarily be increased and additional income made available. This, then, has been one of the aims of the bureau's investigation.

Another point receiving consideration has been the quality of the finished product. Recent development in animal-nutrition studies indicate that products of marine origin have very desirable feeding qualities because they contain valuable proteins, minerals, and vitamins. Formerly the dried scrap produced was marketed entirely as a fertilizer material. It is essential that the quality of the product receive attention because a material produced for fertilizer purposes without consideration of preserving the components of nutritional value is very unlikely to possess the full feeding value of which it is capable.

The studies with respect to the reduction process show at least two important opportunities for improvement. They are (1) the handling and separation of press liquors, and (2) the drying of the pressed fish. The data obtained show that the press liquors contain approximately 22 per cent of the total flesh of the original material. Of this, about 17 per cent is dissolved proteins and about 5 per cent is suspended material. At the present time all dissolved material is discarded and only about one-third of the suspended material is recovered. The data further disclosed that only about 90 per cent of the oil in the press liquors is recovered as first grade oil, about 2 per cent is absolutely lost and the remaining 8 per cent is recovered in such a manner that it has lost approximately half its value.

Several methods of reducing the above losses were studied. Theoretically, all solids now lost in the press liquors would be saved by dry rendering. In this process the raw fish are cooked and dried in one operation in a steam-jacketed batch dryer. Tests with such equipment indicate that menhaden do not react satisfactorily to this type of reduction. Even though the process was carried on under considerably reduced pressure, a dark oil of high acid content resulted. For this reason, further test work was confined to recovery methods adaptable to the present wet process. Tests with a simple rotary screen indicated that over 80 per cent of the suspended material could be recovered. This would amount to an increase of approximately 2 per cent of the total amount of scrap produced. Data obtained on the amount of liquors and the content of dissolved materials present indicated that this material could be recovered at a profit in suitable evaporating equipment. Tests with mechanical separators also showed that the present oil loss could be reduced and the final quality of the oil raised. Data obtained on methods of drying press cake indicate that the present method of drying causes an actual loss of material and, no doubt, decreases the potential feeding value of the finished product. Further studies on drying show that by drying the material in a continuous steam dryer of relatively high capacity for this type of equipment, the value of the meal obtained from a similar quantity of fish can be increased about 6 per cent. This increase is due to the elimination of dust losses, and the reduction of distillation and burning losses by drying at lower temperatures. In addition the quality of the meal has been raised, according to preliminary feeding tests, and the product is capable of demanding a higher price and should cause an increase in the demand for this type of material.

Considerable attention was also given to the matter of proper storage conditions aboard vessel and at the factory. At the present time vessel operation is not efficient on account of the many trips to the factory where small catches of fish are brought in at little or no profit in order to prevent their spoilage before being reduced. In order to prevent additional spoilage at the factory, the plant capacity is such that the fish may be reduced within a few hours after their arrival. This necessitates high-capacity equipment and a large amount of labor that is only used for a few hours each day. Idle machinery and laborers increase production costs. Studies were conducted on the keeping qualities of fish at various temperatures. The results show that fish chilled to and maintained at temperatures between 35° F. and 40° F. are in as good condition for reduction purposes after five or six days storage as fish handled by present methods after only 24 hours.

A complete report of the bureau's study of the menhaden industry is being prepared for publication.

REDUCTION OF WASTE FROM NONOILY FISH

During the past year the bureau continued its studies of methods of reducing the waste from nonoily fish. This type of waste contains a considerable amount of glue material, which causes sticking within the dryer and forms an insulating coat of material on the inner surface of the drying chamber. Most operators overcome this difficulty by using a wet process in which the material is cooked and pressed before drying is attempted. In doing this, much of the gluey material is eliminated and the difficulty of drying is reduced. This procedure makes it necessary to cook and press the material and causes a loss of protein material in the press liquors. The bureau's studies have shown that the material can be handled with some success in one operation, if dried under considerably reduced pressure. To eliminate the sticking, however, it was found necessary to reduce the size of the initial charge and have scraping blades on the agitator come in direct contact with the dryer walls. This latter effect was accomplished by having the scraper blade forced ahead of the agitator paddle and held against the inner walls of the dryer by means of strong springs. The spring blade arrangement allows for contraction and expansion of the metals due to changes in temperature. While these results show some improvement, they are not entirely satisfactory since capacity has necessarily been sacrificed and horsepower requirements increased. Further work on this problem is contemplated.

WASTE FISH AND SHARKS

Many fishermen in isolated localities catch, along with the marketable fish, small amounts of fish considered undesirable for human consumption. In most cases the supply is too small to warrant the installation of reduction machinery and is not utilized. Recently one of the bureau's technologists conducted a series of tests on the acidulation of raw shark flesh and flesh from waste fish taken by Florida trap-net fishermen. It was found that by mixing the material, finely chopped, with as little as 5 per cent by weight of commercial sulphuric acid, decomposition would be arrested and the material could be dried in the sun in the course of two or three days. This product would make a very desirable fertilizer material. Best results were obtained by spreading the acidulated material in a thin layer on flakes constructed of acid-resisting material and so setting them above the ground that the air had access to the lower surface of the layer as well as the top. By this simple procedure many fishermen, without any considerable effort or expense, can realize a profit from material that is now nothing more than a nuisance.

NUTRITIVE VALUE OF FISHERY PRODUCTS

The bureau has undertaken an extensive program of cooperative research in which the nutritive value of marine products is being studied. There are two incentives back of this work: One is that certain nutritional research is necessary for the furtherance of certain phases of technological investigations of the bureau, and the other incentive is the ever-increasing scientific knowledge that marine products are unexcelled in nutritive value.

The bureau's investigator at Johns Hopkins University has completed a series of studies of the general feeding value of fish meals and shellfish meals and the results will soon be published. These experiments have covered a period of approximately two years and they have had the following purposes in mind or have been studied from the following viewpoints: (1) As sources of protein, (2) comparison on an equal weight basis of different meals made by different methods of manufacture, (3) comparison with packing-house products, (4) preliminary investigations of the effect of free fatty acids in the diet. It was found that differences in nutritive value of the various meals lie not only in the variety of meal used, but also in the various methods of manufacture of the same material. In general, it was demonstrated that vacuum and steam dried products were superior to flame-dried products. Steam and vacuum dried menhaden meals were superior to flame-dried menhaden meal and vacuum-dried whitefish meal was superior to flame-dried whitefish meal.

According to data obtained in these experiments, meals rated as follows in nutritive value: (1) Vacuum-dried whitefish meal and steam-dried menhaden meal of about equal feeding value, (2) flame-dried pilchard (California sardine), (3) flame-dried whitefish meal, (4) flame-dried menhaden meal, (5) shrimp meal.

In comparing packing-house products with fish meals, a high-grade specially desiccated meat meal prepared from condemned carcasses and obtained from the United States Department of Agriculture was found to be about equal to the flame-dried fish meals. Commercial meat meal was decidedly inferior to any of the fish meals and commercial tankage was very poor. Extracted menhaden fish meal was inferior to commercial unextracted menhaden fish meal. The addition of 5 per cent of oleic acid to the diets proved very detrimental to the animals. Fish meals were found to be a much better source of protein than casein. It was also found that when calcium or phosphorus was added to the diets containing fish meals no better growth response resulted than when none was added. This would seem to indicate that fish meal is in itself an adequate source of calcium and phosphorus in the diet, and that it is not necessary to supplement fish meal with these minerals.

The bureau has also undertaken, in cooperation with the Bureau of Chemistry and Soils of the United States Department of Agriculture in the laboratories of the protein and nutrition division of that bureau, a cooperative research program involving the determination of the comparative vitamin values in fish oils. The total production of fish oils in this country during 1929 was over 12,000,000 gallons. The six most important oils, exclusive of cod-liver oil, are: Pilchard (California sardine), menhaden, Alaska herring, salmon, Maine herring, and tuna; and their annual production ranges from approximately 6,500,000 gallons for pilchard to 60,000 gallons for tuna. At the present time these oils are used principally in the soap industry, as drying oils in the paint industry, and also to some extent for leather sizing and tempering steel. This investigation was designed to find new uses for these commercial fish oils. Preliminary data indicate that commercial tuna oil is superior to the best obtainable grade of medicinal cod-liver oil in potency of vitamin D, and that commercial pilchard oil is equal to the best grade of medicinal cod-liver oil in this respect. As regards vitamin A potency, the commercial fish oils did not show up as well as medicinal cod-liver oil. Commercial salmon oil is approximately half as potent in vitamin A as medicinal cod-liver oil. The low content of vitamin A in these commercial oils is probably due to the high degree of heat and oxidation to which these oils are subjected in their method of production over a relatively long period of time.

The importance of these results to the fish-oil industries of the United States can not be too greatly emphasized, for it means that for some of these oils, at least, a new field of usefulness, namely, that of animal nutrition, has been opened. Undoubtedly, improvements in the method of production of these oils would greatly reduce losses of potency.

In the cooperative program with the Bureau of Chemistry and Soils, studies of the vitamin potency of fish meals and of oysters have been started.

Arrangements have been made for practical feeding tests in which various kinds of fish meals and shellfish meals are being fed in the rations of dairy cows. This is a cooperative project involving 60 cows located on a dairy farm near Washington. These practical tests are the most comprehensive of their kind ever to be conducted in this country and the results should have far-reaching importance. A number of outside agencies are vitally interested and are cooperating in this undertaking. It is expected that the tests will be completed during the coming year.

In addition to the above-mentioned cooperative projects, the bureau has under way a number of other cooperative practical feeding tests now being conducted by various Federal and State agricultural experiment stations.

During 1929 the bureau published Document No. 1065, entitled "Bibliography on Cod-liver Oil in Animal Feeding, with Noncritical Comments and Abstracts." This publication contains more than 200 references on this subject and has proved of value to both fishery and agricultural industries.

IMPROVED HANDLING OF FRESH AND FROZEN FISH

RUSTING AND PREVENTIVE MEASURES

One of the problems confronting the producers of frozen fish is the oxidation of the fats in fish causing them to "rust." This is the result of a chemical reaction between the oxygen of the air and the oil and fat found in fish. It is particularly noticeable on the cut surfaces of the fish where the protective covering of the skin has been removed. In order to prevent this reaction it is necessary to protect this cut surface from contact with the air. The usual method for accomplishing this is by glazing the fish with a thin coat of ice. This, however, evaporates, and it has been found necessary to reglaze them at frequent intervals, which adds to the cost of storage. Several different methods are being tried for prevention of the contact between the surface of the fish and the oxygen of the air, and the preliminary results seem to indicate that some of these will prove very satisfactory.

LEACHING OF FOOD AND MINERAL VALUES

I has been recognized for several years that there is appreciable loss of food value and mineral constituents when fish are packed in contact with crushed ice. The water from the melting ice drips over the fish and results in a leaching effect.

The losses incurred in weight of the fish and food and mineral value have never been determined, and very little has been done to prevent losses of this nature. In preliminary experiments it was found to be as high as 4 pounds per ton over a period of seven days. This apparently is not a great loss until it is multiplied by the amounts of fish handled in crushed ice over a period of a year; then it begins to assume proportions which are really surprising.

In this same consideration it should be emphasized that the flavor and mineral constituents of the fish are the most important constituents which are most readily lost by leaching, and if losses of this nature are reduced the taste and food value of the fish will be little impaired from that as originally caught.

FORKING FISH ELIMINATED

It has been the universal practice to use forks for transferring fish when unloading the catch; this is detrimental to the fish, for the reason that the holes made by the forks allow bacteria to gain more ready access to the flesh of the fish, which in turn causes more rapid deterioration of the fish.

At the Boston fish pier, platforms have been installed for unloading the vessels and boats which eliminates to a large extent the use of the fork. Besides this, the platform method eliminates a part of the labor and makes it possible to unload more rapidly. This platform has not been universally adopted as yet, but progress is being made with this method. A plan has been developed and adopted by the board of directors of the Boston Fish Market Corporation for unloading vessels and boats by mechanical means, which will entirely eliminate the forking.

In order that more efficient work could be done in filleting fish a table was introduced with the cooperation of some of the packers. This was found to be of value in the elimination of false motion and has been adopted by three of the leading packers on the pier.

MECHANICAL FISH SCALERS

Removing the scales from fish has heretofore been accomplished entirely by hand, and is a slow and tedious process. Some of the large firms developed a machine for accomplishing this process in their plants, but these machines were not adapted to the small operator. However, a small machine for use in the smaller houses has been developed by a commercial company and found to be more satisfactory than the hand method.

IMPROVEMENTS ON TRAWLERS

Previously the bins of the trawlers have been so large that the fish which were placed in the bins first or in the bottom of the bin were exposed to the pressure of the entire load and were damaged materially by this excessive pressure. This has been remedied by making the bins smaller, which decreases the pressure and produces a higher quality fish.

The supports for these bins were constructed of wood and unpainted. The bacteria found ready entrance into the pores of the wood and it was found to be impossible to clean them and prevent the infection of the fish immediately upon placing them in the bins. At the suggestion of the representatives of the bureau, these supports on some vessels are now constructed of iron and are painted white.

The trawlers are now adopting insulation for the holds so that the fish are maintained at a lower temperature and there is also an appreciable saving of ice. Some of the vessels have insulated only the bulkhead between the hold and the engine room; others have insulated the entire hold, which is undoubtedly the most satisfactory and facilitates a greater saving of refrigeration.

PROBLEMS OF HANDLING FISH LIVERS

The oil from livers of certain fish taken in the North Atlantic is valuable for medicinal and nutritive purposes. In order that oil of the highest grade can be extracted from the livers it is necessary to handle them carefully. Several of the larger vessels are equipped with extraction facilities on board so that the oil is recovered while the livers are in prime condition.

On those vessels not equipped with apparatus for the immediate extraction of the oil, difficulty is encountered in preserving the livers until they reach the shore extraction plants. It was suggested to the operators of these vessels that barrels containing the livers be covered for protection against the entrance of water which is very detrimental. This suggestion was adopted with an apparent improvement in the quality of livers landed at the extraction plants.

Instructions as to those livers which were and which were not valuable for medicinal and nutritive purposes were given to the fishermen. This resulted in an improvement in the quality of oil produced.

Another suggestion which was adopted and which was found to increase the value of the livers was that of storing them in the refrigerated holds of the vessel. Storage here, which is at a low temperature, reduced the deterioration of the livers, which in turn produced a higher grade oil.

GENERAL SERVICE

Research is not the only important function of the technologists of this division. The dissemination of information of a technological nature to the industry is a duty which requires an increasing amount of time, year by year, as the technological activities of the bureau become enlarged. This information is distributed partly by correspondence and personal conferences with people that have for discussion problems too intricate to handle through correspondence. This technological consultation service is of considerable value to the industry, because, through past years of research, the bureau has acquired in its files a great amount of scientific knowledge in the different fields of fishery technology. Not only have the industries of this country taken advantage of such service, but, inquiries have been received from the fishery industries of Canada, Mexico, England, Norway, Sweden, Portugal, South America, India, South Africa, Haiti, Porto Rico, Japan, Siam, Austria, Czechoslovakia, France, Germany, Russia, Egypt, Panama, Spain, and Holland.

As chemists and technologists enter the service of the bureau it becomes necessary to especially equip them with knowledge concerning the fishery industries for very few scientists, no matter how well trained or experienced they may be, have had experience in fishery technology prior to entering the bureau's service. However, in acquainting the newer technologists with the industries at first hand, the bureau has established many valuable contacts to the mutual benefit of the industry and to the bureau, for by visiting the plants in the industry, technologists have sometimes been able to offer valuable suggestions for improvements from their general knowledge concerning good engineering and chemical practice, as obtained from related industries.

MARKET AND INDUSTRIAL SURVEYS

Market and industrial surveys are made to supply the trade with useful market information regarding the distribution and consumption of fishery products and to supply descriptive and economic data on our fisheries and fishery industries.

FACILITIES FOR FREEZING AND WAREHOUSING FROZEN FISHERY PRODUCTS

During late years the freezing and storing of fishery products has assumed unusual importance in this and other countries. In 1929 the amount of fish frozen in this country reached the largest proportions on record, amounting to about 122,000,000 pounds, with an estimated value in the cold-storage warehouses of $15,000,000. This is an increase of 7 per cent in volume over 1928. The increase in late years has been due almost entirely to the larger pack of frozen package fish products consisting mainly of haddock fillets, the production of which in 1929 amounted to 21,800,000 pounds valued at about $4,000,000.

In order to learn conditions surrounding the frozen-fish trade in the United States and Alaska, a survey was made during 1929 by the writer through questionnaires and by personal contact with the firms known to be publicly or privately engaged in it. It is believed that in this manner about 98 per cent of the trade was canvassed.

FREEZING FACILITIES

According to the data collected in 1929, there were 122 plants in the United States and Alaska which made a practice of freezing fishery products. Of this number 65 are located along the seacoast, 38 along our lake shores, and 19 at points in the interior of the country. Of those along the water front, 77 are located so that fishing boats and vessels can be unloaded directly at the pier of the freezing plant. The location of these is shown in Figure 1. Some of the plants use "rapid" freezing methods to perform the operation, although a majority use the "slow" or "sharp" freezing methods. Most of the plants are publicly operated, but there appears to be a distinct trend toward the privately owned plant. These latter are owned chiefly by firms packing frozen-package fish products. The freezing plants are most numerous in the northern latitudes, few being located in our southern sections.

These plants are capable of freezing about 3,617,000 pounds of fish per working day, or roughly, about 1,000,000,000 pounds per year of 300 working days. At this rate it might be assumed that present facilities are sufficient to freeze all of the fish marketed in a condition other than that canned or cured, for, annually, about 1,000,000,000 pounds of fishery products are marketed in the fresh and frozen condition. However, this is far from true, for, like any plant preserving a seasonal article, it must be equipped to handle the peak loads, as generally there is not a steady flow of fish through the plants. A plant interested primarily in freezing a seasonal article, such as fish, finds it necessary to provide machinery to care for the peak load. At other seasons of the year it may be more or less idle, as is the case with that in a plant canning a seasonal product. For this reason it may be necessary, for several years to come, to erect freezing plants especially near points of production.

It is especially desirable that fish-freezing plants be located near centers of production for the following reasons: First, the fish can be unloaded from the fishing vessels directly to the freezing rooms. Second, the fish need not be barreled, boxed, or iced for transportation to the freezer. Third, there is a saving in transportation charges, for, when ready for distribution, the frozen fish can be forwarded by freight in carload lots to distribution centers, rather than by express in less than carload lots. Fourth, overhead expenses generally are less in a freezer located at the fishing port. And fifth, the quality of the fish before freezing is known.

In the New England section facilities are available to freeze 1,034,000 pounds of fish per working day. In the Middle Atlantic section 777,000 pounds can be frozen; in the Pacific section and Alaska,

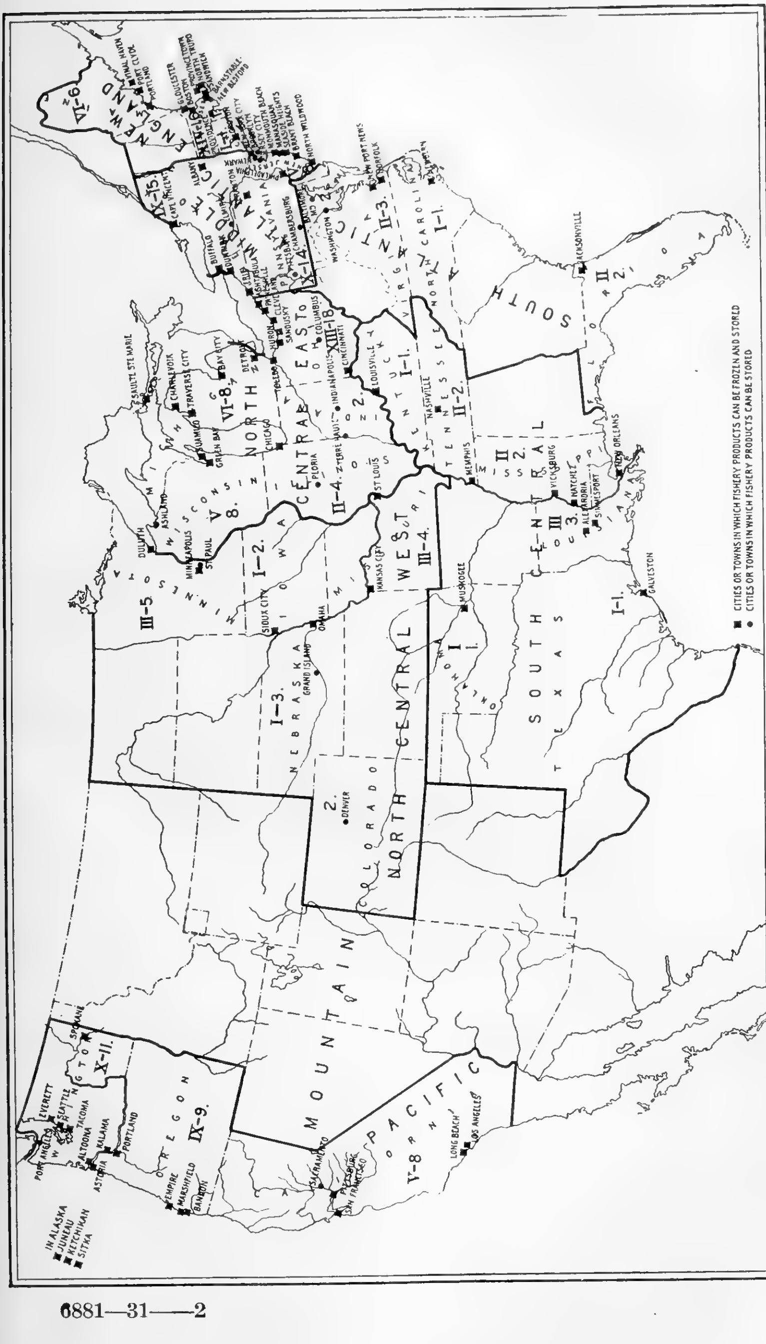

FIGURE 1.—Cities or towns in the United States in which fish-freezing plants and cold-storage warehouses are located. Arabic numbers indicate the number of cold-storage warehouses in a State; roman numerals the number of freezing plants in the State

869,000 pounds; and in the North Central, East, section, 484,000 pounds. Each of the other sections is equipped to freeze between 100,000 and 200,000 pounds per working day.

WAREHOUSE FACILITIES

Every freezing plant operates a cold-storage warehouse in connection with it, and, in addition, there are numerous cold-storage warehouses located at strategic consumption or distribution centers. In all, there are 168 such warehouses in the United States and Alaska. From 24 to 40 are located in each of the following sections: New England; Middle Atlantic; North Central, East; and Pacific. The other sections have 4 to 16 each. The location of these warehouses is shown in Figure 1. Practically every section of the country except the Rocky Mountain region and the extreme southeast has a cold-storage warehouse for holding fishery products at distances not more than 200 to 300 miles apart.

Facilities for the cold storage of frozen fish at consumption centers enables economy in marketing of these products. Carload lots can be delivered by rail at low rates to these warehouses, stored there, and later distributed to the surrounding territory by motor truck or express in less than carload lots.

The cold-storage warehouses in the United States and Alaska during 1929 were capable of holding a maximum of 209,660,000 pounds of fishery products at one time. On the basis of 1 ton occupying 40 cubic feet of space, this would be the equivalent of 4,193,000 cubic feet. This is a mere fraction of the total refrigerated space available in the United States for all food commodities, for, according to the Department of Agriculture reports, the total refrigerated space in this country amounts to about 668,000,000 cubic feet.

The New England section has the most space available for holding frozen fish and can warehouse 58,755,000 pounds; 40,122,000 pounds can be stored in the Middle Atlantic section; 35,746,000 pounds in the North Central, East, section; 26,565,000 pounds in the Pacific section; 20,820,000 pounds in the North Central, West, section; 18,000,000 pounds in Alaska; 6,950,000 pounds in the South Atlantic section; and 2,702,000 pounds in the South Central section. The space available in the various sections indicates that on the basis of maximum holdings in 1929 two to four times as much frozen fish can be stored in the various sections as are now stored, and over the country as a whole about three times as much can be stored. However, while certain sections appear to have additional space available, that section between the Mississippi River and the Rocky Mountain region appears to be undersupplied with space.

WATER AND RAIL FACILITIES AT PLANTS AND WAREHOUSES

Of the warehouses freezing and storing frozen fish, 77 are located directly along the water front, and 103 have railroad spur tracks connecting with one or more railroads entering the city in which they are located. These can accommodate 620 freight cars at one time.

Cities or towns in the United States and Alaska in which fish-freezing plants and cold-storage warehouses were located in 1929

State and city or town	Freeze	Store
	Number	*Number*
Maine:		
Port Clyde	1	1
Portland	4	4
Vinal Haven	1	1
Massachusetts:		
Barnstable	1	1
Boston	3	3
Gloucester	3	4
New Bedford	-------	1
North Truro	1	1
Provincetown	5	5
Sandwich	1	1
Rhode Island: Providence	-------	1
Connecticut: Groton	1	1
New York:		
Albany	1	1
Buffalo	2	3
Brooklyn	-------	1
Cape Vincent	1	1
Dunkirk	1	1
Elmira	-------	1
New York	4	7
New Jersey:		
Jersey City	-------	1
Manasquan	1	1
Monmouth Beach	1	1
Newark	-------	2
North Wildwood	1	1
Seaside Heights	1	1
Brant Beach	1	1
Pennsylvania:		
Chambersburg	-------	1
Erie	7	8
Philadelphia	2	3
Pittsburgh	-------	1
Scranton	1	1
Mar yland: Baltimore	-------	2
District of Columbia: Washington	-------	1
Virginia:		
Newport News	1	1
Norfolk	1	2
North Carolina: New Bern	1	1
Florida: Jacksonville	2	2
Ohio:		
Ashtabula	1	1
Cincinnati	1	1
Cleveland	1	4
Columbus	-------	1
Painesville	1	2
Huron	3	3
Sandusky	5	5
Toledo	1	1
Indiana:		
Indianapolis	-------	1
Terre Haute	-------	1
Illinois:		
Chicago	2	2
Peoria	-------	2
Michigan:		
Bay City	1	2
Charlevoix	1	1
Michigan—Continued.		
Detroit	2	3
Saulte Ste. Marie	1	1
Traverse City	1	1
Wisconsin:		
Ashland	-------	1
Green Bay	4	6
Suamico	1	1
Minnesota:		
Duluth	2	2
Minneapolis	1	2
St. Paul	-------	1
Iowa: Sioux City	1	2
Missouri:		
Kansas City	2	2
St. Louis	1	2
Nebraska:		
Grand Island	-------	1
Omaha	1	2
Colorado: Denver	-------	2
Kentucky: Louisville	1	1
Tennessee:		
Memphis	1	1
Nashville	1	1
Mississippi:		
Natchez	1	1
Vicksburg	1	1
Louisiana:		
Alexandria	1	1
New Orleans	1	1
Simmesport	1	1
Oklahoma: Muskogee	1	1
Texas: Galveston	1	1
Washington:		
Altoona	1	1
Everett	1	1
Kalama	1	1
Port Angeles	-------	
Seattle	5	5
Spokane	1	1
Tacoma	1	1
Oregon:		
Astoria	4	4
Bandon	1	1
Empire	1	1
Marshfield	1	1
Portland	2	2
California:		
Long Beach	1	1
Los Angeles	1	2
Pittsburg	1	1
Sacramento	-------	2
San Francisco	2	2
Alaska:		
Juneau	1	1
Ketchikan	2	2
Sitka	1	1
Total	122	168

Location of fish-freezing plants and cold-storage warehouses for fish, with respect to geographic situation, in 1929

Section and State	Seaboard		Lakes		Inland		Total	
	Freeze	Store	Freeze	Store	Freeze	Store	Freeze	Store
New England:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Maine	6	6					6	6
Massachusetts	14	16					14	16
Rhode Island		1						1
Connecticut	1	1					1	1
Total	21	24					21	24
Middle Atlantic:								
New York	4	8	4	5	1	2	9	15
New Jersey	5	8					5	8
Pennsylvania	2	3	7	8	1	3	10	14
Total	11	19	11	13	2	5	24	37
South Atlantic:								
Maryland		2						2
District of Columbia		1						1
Virginia	2	3					2	3
North Carolina	1	1					1	1
Florida	2	2					2	2
Total	5	9					5	9
North Central, East:								
Ohio			12	16	1	2	13	18
Indiana						2		2
Illinois			2	2		2	2	4
Michigan			6	8			6	8
Wisconsin			5	8			5	8
Total			25	34	1	6	26	40
North Central, West:								
Minnesota			2	2	1	3	3	5
Iowa					1	2	1	2
Missouri					3	4	3	4
Nebraska					1	3	1	3
Colorado						2		2
Total			2	2	6	14	8	16
South Central:								
Kentucky					1	1	1	1
Tennessee					2	2	2	2
Mississippi					2	2	2	2
Louisiana	1	1			2	2	3	3
Oklahoma					1	1	1	1
Texas	1	1					1	1
Total	2	2			8	8	10	10
Pacific:								
Washington	9	10			1	1	10	11
Oregon	9	9					9	9
California	4	4			1	4	5	8
Total	22	23			2	5	24	28
Alaska	4	4					4	4
Grand total	65	81	38	49	19	38	122	168

Number of fish-freezing plants and cold-storage warehouses in the various geographical sections and their capacities and facilities in 1929

Sections	Freezing plants	Maximum amount that can be frozen in 1 working day	Warehouses	Maximum amount that can be stored at one time	Warehouses on waterfront	Warehouses with railroad connection	Freight cars that can be handled at one time
	Number	*Pounds*	*Number*	*Pounds*	*Number*	*Number*	*Number*
New England	21	1,034,000	24	58,755,000	19	10	36
Middle Atlantic	24	777,000	37	40,122,000	10	21	129
South Atlantic	5	197,000	9	6,950,000	3	8	32
North Central, East	26	484,000	40	35,746,000	24	25	194
North Central, West	8	98,500	16	20,820,000	2	13	85
South Central	10	157,500	10	2,702,000	1	5	23
Pacific	24	614,000	28	26,565,000	14	21	121
Alaska	4	255,000	4	18,000,000	4		
Total	122	3,617,000	168	209,660,000	77	103	620

NOTE.—The New England section includes Maine, Massachusetts, Rhode Island, and Connecticut; Middle Atlantic—New York, New Jersey, Pennsylvania; South Atlantic—Maryland, District of Columbia, Virginia, North Carolina, and Florida; North Central, East—Ohio, Indiana, Illinois, Michigan, and Wisconsin; North Central, West—Minnesota, Iowa, Missouri, Nebraska, and Colorado; South Central—Kentucky, Tennessee, Mississippi, Louisiana, Oklahoma, and Texas; Pacific section—Washington, Oregon, and California; and Alaska.

OYSTER MARKET SURVEY

While the culture of oysters has made rapid progress in recent years, distribution through retail channels has not increased accordingly. In order to determine the factors limiting demand for this commodity, the bureau in cooperation with the Oyster Growers and Dealers Association of America (Inc.), and certain State officials, conducted a survey of the markets for oysters in various cities during the fall and winter months of 1929. This survey was conducted by making personal contacts with approximately 120 retail and wholesale dealers and 1,400 housewives in 14 cities of 13 States. Their reactions toward oysters as a food was noted.

The results of this survey show that 86.8 per cent of those interviewed serve oysters from 1 to 122 times per year. The per capita consumption of this sea food was found to be an average of 4.2 pounds per year in the cities surveyed. The highest per capita consumption was found to be 9.6 pounds per year in St. Paul, Minn., while the lowest was 2.6 pounds per year in Washington, D. C. Out of a possible 98 methods for preparing this food, only 15 were reported as generally used. Of those who reported, 52 per cent stated that their usual method of cooking was as a stew, while 39 per cent reported frying as their usual method.

Results of the interviews with retail dealers and wholesalers show that 58 per cent of them advertise in some form, and that the city having the highest per capita consumption also has the greatest number who advertise. The most popular size container is that of 1 pint. The largest per cent of weekly sales was found to be on Friday. The largest monthly sales were found to be made in December.

PUBLICATIONS OF THE DIVISION

During the calendar year 1929 the following publications were prepared and issued by this division. The list does not include the monthly statistical bulletins of the landings of fish at Boston and Gloucester, Mass., Portland, Me., and Seattle, Wash., nor the monthly reports on cold-storage holdings of frozen fish. The documents may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at the prices shown. The statistical bulletins are distributed free of charge upon request. Persons interested in securing the statistical bulletins as released may have their names placed on the bureau's mailing list upon request.

DOCUMENTS

Fishery industries of the United States, 1927. By Oscar E. Sette and R. H. Fiedler. 8°, 147 pp. Document No. 1050. 25 cents.

Fishing grounds of the Gulf of Maine. By Walter H. Rich. 8°, 67 pp., 5 figs. Document No. 1059. 25 cents.

Bibliography on cod-liver oil in animal feeding, with noncritical comments and abstracts. By John Ruel Manning. 8°, 33 pp. Document No. 1065. 10 cents.

Fishery industries of the United States, 1928. By R. H. Fiedler. 8°, 224 pp. Document No. 1067. 35 cents.

ECONOMIC CIRCULARS

Goldfish industry. By Thomas Quast. 8°, 14 pp., 5 figs. No. 68. 5 cents.

STATISTICAL BULLETINS

Fisheries of the Gulf States, 1927. Statistical Bulletin No. 815.

Fisheries of the South Atlantic States, 1927. Statistical Bulletin No. 819.

Fisheries of the Pacific coast, 1926. Statistical Bulletin No. 820.

Canned fishery products and by-products of the United States and Alaska, 1928. Statistical Bulletin No. 821.

Fishery products landed by American fishing vessels at Seattle, Wash., 1928—by banks—by months. Statistical Bulletin No. 825.

Landings by fishing vessels at principal New England ports, 1928 (by months). Statistical Bulletin No. 829.

Landings by fishing vessels at the three principal New England ports, 1928 (by gear and fishing grounds). Statistical Bulletin No. 830.

Fisheries of Alaska, 1928. Statistical Bulletin No. 831.

Fisheries of United States and Alaska. Statistical Bulletin No. 832.

Fisheries of the Pacific Coast States, 1927. Statistical Bulletin No. 839.

Part 2. FISHERIES STATISTICS

REVIEW

The fisheries of the United States and Alaska continue to be in a sound economic position, according to the most recent statistics available. They now employ over 128,000 commercial fishermen and over 4,000 persons are employed in transporting fishery products from the fishing grounds to market, or from port to port. The annual catch amounts to 3,090,000,000 pounds, valued at about \$116,000,000. Of this total annual yield, 2,662,000,000 pounds consist of edible fishery products and 428,000,000 pounds consist of nonedible fishery products which are manufactured into commodities used in the arts and industries.

In 1929, the production of canned fishery products amounted to 689,447,000 pounds, valued at \$101,065,000, and the output of by-products was valued at \$23,768,000. Cold-storage holdings of fish averaged about 56,000,000 pounds monthly, while 121,543,000 pounds of fishery products were frozen. The production of fresh and frozen package fish amounted to 84,397,000 pounds, valued at \$14,813,000.

The production of goldfish was valued at about $1,000,000. Imports of fishery products were valued at $66,566,000, while exports were valued at $23,830,000. Compared with 1928, the value of canned fishery products and by-products was greater. More fish were frozen; larger quantities of packaged fish were produced, and the value of both imports and exports of fishery products was greater.

NEW ENGLAND STATES

According to the latest statistics for the fisheries of these States, the value of the catch in 1928 exceeded that in any year upon which there are records, while the volume of the catch exceeded that in any year during the past 39 years. Compared with the latest previous records, which are those for 1924, the catch increased 48 per cent and its value 36 per cent. This is due almost entirely to the larger catch of haddock, which is utilized chiefly by the fresh and frozen package fish trade. The output of package fish in these States registered practically a 50 per cent increase compared with the production in 1928. To supply the demand for raw fish by the fish packers more vessels equipped with otter trawls to enter the haddock fishery were added to the fleet, so that in 1929, 326 vessels of 5 net tons or over (38 more than in 1928) were outfitted with this gear and operated from Boston, Gloucester, and Portland. Landings of fish at these three ports in 1929 were larger than in any previous year, and the value received for this volume was also greater than in any one year. Landings of fish at various other New England ports in 1929 also increased, notably at Groton, Conn. The frozen-fish trade in 1929 showed increased business over that in 1928, due largely to the greater amount of haddock fillets which were frozen. The production of the sardine industry, which is the principal fish-canning industry in these States, decreased somewhat from that in 1928, but was well above the average annual pack since 1921. The cured-fish industry, long associated with the New England States and one of the principal fish-manufacturing industries of this section, showed a decline in production in 1928 compared with that in 1924, which is the latest previous year upon which there are records.

MIDDLE ATLANTIC STATES

According to the latest general statistical canvass of the fisheries of these States, made for 1926, the situation here is not encouraging. The production of many of the staple fish shows tremendous declines in 1926 under that for 1921. Notable examples of this are bluefish, which show a decline of 72 per cent; scup, 37 per cent; and squeteague, or weakfish, 36 per cent.

Landings of fish at New York City and Groton, Conn., which consisted largely of haddock, flounders, cod, and mackerel, increased in 1929 over those for 1928. The haddock were used mainly by the rapidly growing package-fish trade in the manufacture of fish fillets.

The production of the menhaden industry in 1929 declined somewhat under that for 1928. The catch of shad in the Hudson River in 1929 was somewhat less than that in 1928, although it was about equal to the average annual catch during the past 10 years. The pack of frozen fish was smaller in 1929 than in 1928.

CHESAPEAKE BAY STATES

As the latest general statistical canvass of the catch of fishery products for this region was made for 1925, no other later data are available on the condition of the catch of fishery products in these States. However, the general trend of the fisheries may be obtained from a study of the statistics, which are of more recent date, of the canning and by-products industries and certain other industries.

The menhaden industry recovered somewhat from the poor year of 1928 and produced a larger quantity of scrap and meal, but the value did not increase accordingly and barely exceeded that for 1928. Less oil with a less value was produced in 1929 as compared with 1928, with the net result that the total value of the menhaden industry in Virginia in 1929, in spite of increased production, was about the same as in 1928. This situation should bring home to the menhaden manufacturers that it should improve methods for the manufacture of their menhaden meal and oil with a view toward the production of a higher-grade product. To produce such a product would require but little additional expenditure in improving manufacturing methods.

In 1929 the alewife canning industry produced products which about equaled the amount canned in 1928. The production of the oyster industry changed little from the previous year. Some difficulty has been experienced in marketing oysters, as distribution through retail outlets has not kept pace in some parts of the country. The crab industry had one of its best years in history in 1929, according to reports of persons in the trade. The production of package fish in 1929 about equaled that for 1928. The catch of shad on the Potomac River in 1929 was somewhat less than that made in 1928, and about one-fourth less than the average annual catches during the past decade. The catch of alewives was less than that in 1928.

SOUTH ATLANTIC STATES

The fisheries of these States, which are conducted mainly by small operators along the shore, continue to be in a sound position. In 1928 the yield was about 1 per cent less than in 1927, but the value was 6 per cent greater. The production of canned shrimp in 1929 was somewhat higher than in 1928. The menhaden industry, which is rapidly becoming a factor in the fisheries of these States, showed a considerably increased production in 1929 over that in 1928.

GULF STATES

The fisheries of these States were more productive in 1928 than in any year upon which there are records since 1880, except in 1927, from which year they decreased 2 per cent in amount and 1 per cent in value. The production of canned shrimp in 1929 was about the same as in the previous year. The production of canned oysters in 1929 was considerably in excess of the pack in the previous year. The quantity of sponges handled on the exchange in 1929 at Tarpon Springs was below normal in both volume and value.

PACIFIC COAST STATES

The fisheries in these States yielded the greatest volume on record, in 1928, although the value did not keep pace and was less than in 1927. The pack of canned salmon in 1929 was 92 per cent greater than in 1928, due chiefly to an increased pack of pink salmon on Puget Sound, as 1929 was a "good" year for the run of this species of salmon. Compared with the previous "good" year—1927—there was an increase of 8 per cent in the pack. The pack of canned sardines has continued to increase, with that in 1929 exceeding all records, both in volume and value. The tuna canning industry manufactured a larger pack of tuna, breaking all previous records as to volume and value of the pack. The mackerel canning industry, which developed on a large commercial scale in 1928, increased its production by one-half in 1929 compared with the previous year, and the value increased accordingly. The catch of the halibut fleet in 1929 increased slightly over that made in 1928, and was one of the largest catches since 1925. The pack of frozen fish was slightly smaller in 1929 than in 1928.

LAKE FISHERIES

The American fisheries prosecuted in the Great Lakes in 1928 yielded the smallest catch on record. This decrease can not be attributed to a decline in the catch of any one species, for, practically all show a decline compared with their respective catches in 1927. Among these, the catch of ciscoes shows the most serious decline, the catch in 1928 barely exceeding 600,000 pounds compared with a catch of this species of 35,000,000 pounds in 1918. A decrease occurred in the catch of every lake except in Lake Ontario. This condition of the lake fisheries should prove an incentive to the various States and fishermen operating these fisheries to cooperate in an effort to promulgate wise conservation measures.

MISSISSIPPI RIVER AND TRIBUTARIES

No recent general statistical canvass has been made for the catch of fish in this region since 1922, and, therefore, the recent trend can not be determined. The yield of fresh-water mussel shells in 1929 used in the manufacture of pearl buttons and novelties decreased 6 per cent in quantity and increased 4 per cent in value compared with the production and its value in 1922. The fisheries of Lakes Pepin and Keokuk show a decreased yield in 1929 compared with that in 1928.

ALASKA

The fisheries of Alaska experienced another good year in 1929, although the catch and its value was slightly less than in 1928. The salmon canning industry in 1929 put up a 12 per cent smaller pack than in the previous year, but still this pack was above normal. The herring industry experienced another rather poor season, while the halibut fishery was about normal. The pack of frozen fish was slightly larger in 1929 than in 1928.

YIELD OF FOOD FISHERY PRODUCTS, BY VOLUME

As has been stated above, the yield of food fishes in the United States and Alaska amounts to about 2,662,000,000 pounds annually. Some 144 products contribute to this poundage. When considered by individual products, it is found that, according to the latest tabulation, the backbone of our fisheries is made up of 12 groups of products, these accounting for 80 per cent of the entire annual yield. Of first importance is the salmon, which forms the basis of a valuable canning industry on our Pacific coast from California north to the Bering

Sea. Of second importance is the pilchard, which is utilized in California for the canning of sardines. Haddock, which is taken on our North Atlantic seaboard, is third in importance, and is used mainly for manufacture into fillets, which is the basis of the rapidly expanding fresh and frozen package fish trade. Sea herring are fourth in importance. These fish are used extensively in Maine for canning as sardines, in Alaska and New England for salting and smoking, and large quantities also are frozen for use as bait. Oysters are fifth in importance. These are taken commercially in nearly every seacoast State. Those taken in the more northern latitudes generally are marketed fresh, while those taken in the southern States form the basis for an extensive canning industry. Shrimp are sixth in importance and form the basis for the rapidly growing canning industry along the South Atlantic and Gulf coasts. Cod, which is seventh in importance, is taken mainly in the vessel fisheries prosecuted from the New England States, and is used extensively for salting. Mackerels, eighth in importance, are taken in our North Atlantic sections and also in California. Those on the Atlantic seaboard are marketed mainly fresh and frozen, although considerable quantities are salted and

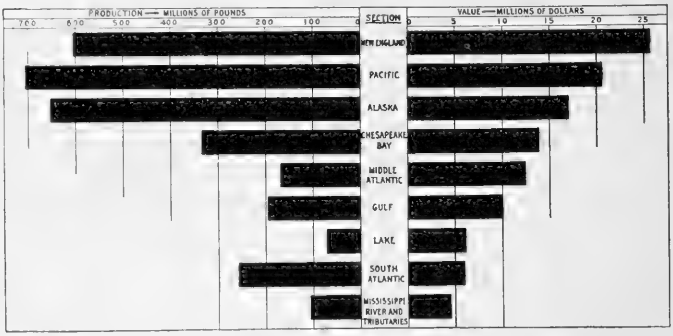

FIGURE 2.—Production and value of the fisheries of the various sections of the United States and Alaska

canned; while those taken in California are used almost entirely for canning. Flounders, which rank ninth in importance, are taken in the marine fisheries of all sections. Tuna and tunalike fishes, tenth in importance, are native to the waters of California, and the high seas of the Pacific south from that State to Chile. These fishes form the basis for an important canning industry in California. Halibut, which are of eleventh importance in volume, are taken principally in the North Pacific, and are distributed in the fresh and frozen condition to all parts of the country. Crabs, which are of twelfth importance, are taken chiefly in the Chesapeake Bay region, where they form one of the most important fisheries there.

Since these 12 groups of products provide the backbone of our fisheries, it is important that their numbers be conserved for any diminution in the supply of any of these products is striking at the very root of our national fisheries prosperity. It is gratifying to learn that 10 of these fisheries are now under study by State or Federal Governments and by the time that this is published the remaining two will be under intensive study. Biological study of the Alaska salmon fishery and the promulgation of wise conservation measures based upon these studies already have placed this fishery on a sound foundation. So it is with the pilchard fishery of California, the oyster fishery, and the crab fishery. Headway is also being made for conservation of other fisheries.

Among the species of moderate commercial importance are 24 products whose yield makes up 15 per cent of the average annual catch. Included with this group are many whose catch in the past greatly exceeded the present yield—shad, lobster, and sturgeon being conspicuous examples. Many of the species of this group are showing increased yield as time goes on, and possibly greater numbers of these will be taken in the future.

Among the species of least importance are 108 products whose annual catch accounts for only 5 per cent of the total annual yield. In former years some species of this group would have ranked with the first group of products, especially ciscoe taken on Lake Erie. Others in this group are considered of little commercial importance, due either to their very limited supply, or to the inferior quality of the fish.

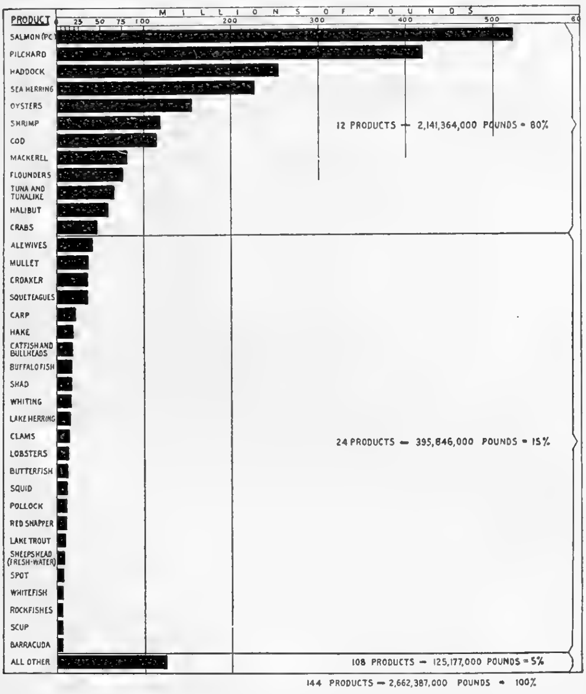

FIGURE 3.—Average annual yield of edible fishery products taken in the United States and Alaska

YIELD OF FOOD FISHERY PRODUCTS, BY VALUE

When considered from a monetary standpoint, 18 products account for 80 per cent of the value of the entire catch. Listed in order of importance they are—salmon, oysters, haddock, halibut, shrimp, lobsters, flounders, cod, tuna and tunalike fishes, mackerel, clams, shad, pilchard, squeteagues, crabs, sea herring, lake trout, and mullet. In this line-up some of those species leading in volume trail behind in value, and with others the case is vice versa. This is noted with pilchards, which are second in volume but thirteenth in value, while oysters are fifth in volume, but second in value. So it will be noted with several of the other products. In the group of moderate importance, 26 products make up 15 per cent of the value, and in the group of least importance, 100 products make up 5 per cent of the value.

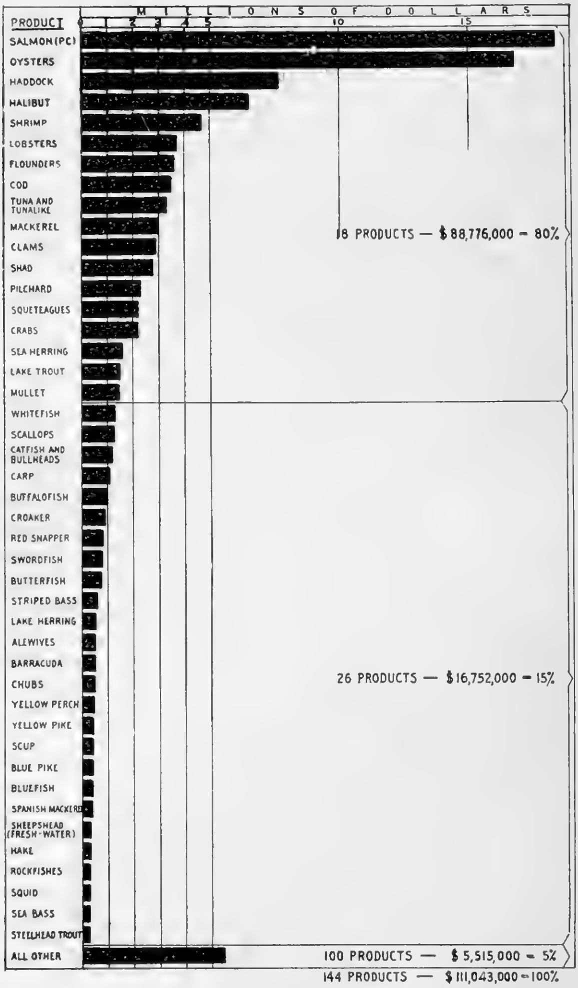

Figure 4.—Average annual value of fishery products taken in the United States and Alaska

YIELD OF NONFOOD FISHERY PRODUCTS

The yield of the nonfood group of fishery products in the United States and Alaska annually amounts to about 428,000,000 pounds, valued at $5,341,000. The most important products in this group, according to volume and value, are—menhaden and fresh-water mussel shells. Menhaden is manufactured into scrap and meal which is later used for fertilizer and feedstuffs, and into oil used chiefly in the manufacture of soap and paint. Fresh-water mussel shells are utilized mainly for the manufacture of pearl buttons and novelties. Other important products in the nonfood group are sponges and whale products.

Fisheries of the United States and Alaska

SUMMARY OF CATCH

[Expressed in thousands of pounds and thousands of dollars; that is, 000 omitted]

Products	New England, 1928		Middle Atlantic, 1926		Chesapeake, 1925		South Atlantic, 1928		Gulf, 1928	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Fish	561, 104	18, 104	119, 021	4, 648	241, 221	6, 092	210, 132	3, 757	71, 375	3, 842
Shellfish, etc	42, 494	7, 516	48, 991	7, 808	91, 985	7, 856	48, 308	2, 270	123, 309	6, 193
Total	603, 598	25, 620	168, 012	12, 456	333, 206	13, 948	258, 440	6, 027	194, 684	10, 035

Products	Pacific, 1928		Mississippi River and tributaries, 1922		Lakes, 1928		Alaska, 1929		Total for the various years	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Fish	686, 525	18, 652	53, 466	3, 310	63, 368	5, 961	640, 490	16, 465	2, 646, 702	80, 831
Shellfish, etc	13, 705	1, 564	52, 268	1, 194	6, 332	237	2, 008	117	429, 400	34, 755
Whale products	4, 881	296					8, 925	502	13, 806	798
Total	705, 111	20, 512	105, 734	4, 504	69, 700	6, 198	651, 423	17, 084	3, 089, 908	116, 384

OPERATING UNITS: BY SECTIONS

Items	New England, 1928	Middle Atlantic, 1926	Chesapeake, 1925	South Atlantic, 1928	Gulf,[1] 1928
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	5, 649	4, 364	3, 800	1, 306	2, 400
On boats and shore	11, 010	5, 607	20, 993	10, 576	14, 232
Total	16, 659	9, 971	24, 793	11, 882	16, 632
Vessels:					
Steam	57	24	44		
Net tonnage	8, 035	3, 038	5, 010		
Motor	645	492	134	130	454
Net tonnage	15, 786	6, 321	1, 307	2, 521	6, 087
Sail	6	101	396	63	64
Net tonnage	188	1, 821	4, 523	568	1, 688
Total vessels	708	617	574	193	518
Total net tonnage	24, 009	11, 180	10, 840	3, 089	7, 775
Boats:					
Motor	5, 871	2, 112	8, 314	2, 809	4, 970
Other	5, 777	2, 392	8, 707	4, 650	5, 914
Apparatus:					
Haul seines	256	412	418	750	718
Purse seines	192	52	56	50	2
Otter trawls (including all types and sizes)	675	196	11	643	2, 183
Gill nets	11, 089	4, 348	22, 393	15, 236	2, 438
Trammel nets				3	687
Pound nets, trap nets, and weirs	635	650	3, 712	2, 443	10
Stop nets		84	9		240
Fyke nets	463	5, 130	4, 131	795	12, 736
Bag nets and pocket nets	146	36			
Other nets [2]	179	183	1, 924	490	12, 146
Hooks, snoods, or baits	5, 109, 766	(3)	(3)	200, 990	183, 811
Fish wheels				5	
Eel pots and traps	5, 273	7, 991	[4] 10, 153	1, 609	
Lobster pots	334, 574	28, 900			
Crab and crawfish pots, traps, drags, etc	2, 449			2, 052	1, 840
Clam dredges	211				2
Crab dredges		12	120		
Mussel dredges		6			
Oyster dredges	307	689	2, 442	204	404
Scallop dredges and drags	3, 627	1, 357	685	773	
Crab scrapes			1, 403		
Tongs, rakes, hoes, forks, etc	2, 900	2, 553	13, 355	3, 280	2, 444
Sponge apparatus					299
Other apparatus [5]	1, 160	(3)	87	171	483

[1] Includes the operating units used in the fisheries of Lake Okeechobee, Fla.
[2] Includes set nets, dip nets, scap nets, reef nets, and other minor nets.
[3] Number not determined.
[4] Includes a few pots fished for catfish in Virginia.
[5] Includes box traps, periwinkle and cockle pots, harpoons, spears, and other minor apparatus not included in "Other nets."

Fisheries of the United States and Alaska—Continued

OPERATING UNITS—BY SECTIONS—Continued

Items	Pacific, 1928	Mississippi River and tributaries, 1922	Lakes,[6] 1928	Alaska, 1929	Total for the various years
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	5,242		1,531	[7] 10,921	35,213
On boats and shore	14,491	12,310	3,907		93,126
Total	19,733	12,310	5,438	10,921	128,339
Vessels:					
Steam	6		134	8	273
Net tonnage	257		2,953	617	19,910
Motor	796		246	726	3,623
Net tonnage	15,105		2,611	11,992	61,730
Sail	8				638
Net tonnage	2,982				11,770
Total vessels	810		380	734	4,534
Total net tonnage	18,344		5,564	12,609	93,410
Boats:					
Motor	6,228	4,597	1,475	1,861	38,237
Other	1,589	10,941	928	3,559	44,457
Apparatus:					
Haul seines	219	708	238	176	3,895
Purse seines	352			703	1,407
Lampara nets	262				262
Otter trawls (including all types and sizes)					3,708
Beam trawls	60			9	69
Paranzella nets	18				18
Gill nets	5,164	866	99,348	4,225	165,107
Trammel nets	71	459			1,220
Pound nets, trap nets, and weirs	750	11	7,943	734	16,888
Stop nets					333
Fyke nets	1,248	49,652	2,455		76,610
Bag nets and pocket nets	8				190
Other nets [8]	413				15,335
Hooks, snoods, or baits	1,345,811	(3)	631,637	(3)	(3)
Fish wheels	30			246	281
Eel pots and traps					25,026
Lobster pots					363,474
Shrimp nets and traps		4,360			4,360
Crab and crawfish pots, traps, drags, etc	20,217		5,255	740	32,553
Clam dredges					213
Crab dredges					132
Mussel dredges					6
Oyster dredges					4,046
Scallop dredges and drags					6,442
Crab scrapes					1,403
Tongs, rakes, hoes, forks, etc	[9] 3,281	1,810	244		29,867
Crowfoot bars (pairs)		3,490	311		3,801
Abalone outfits	18				18
Sponge apparatus					299
Other apparatus [5]	79	(3)			(3)

[3] Number not determined.
[5] Includes box traps, periwinkle and cockle pots, harpoons, spears, and other minor apparatus not included in "Other nets."
[6] The crawfish pots, crowfoot bars, forks, etc., are for 1922.
[7] Includes persons in shore and boat fisheries.
[8] Includes set nets, dip nets, reef nets, and other minor nets.
[9] Includes a few dredges.

NOTE.—Whaling apparatus, the number of which was not determined, was used in the Pacific and Alaska sections.

Fisheries of the United States and Alaska—Continued

CATCH: BY SECTIONS

[Expressed in thousands of pounds and thousands of dollars; that is, 000 omitted]

Species	New England, 1928		Middle Atlantic, 1926		Chesapeake, 1925		South Atlantic, 1928		Gulf,[10] 1928	
FISH	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Albacore			35	1						
Alewives	4,557	52	2,495	47	25,611	294	8,180	114		
Amberjack							12	1	17	1
Angelfish and spadefish					4	(11)	26	1	78	3
Barracuda							12	(11)	4	(11)
Black bass					93	15	231	30	428	42
Bluefish	55	9	922	216	215	27	1,407	119	449	31
Blue runner or hardtail							123	4	445	13
Bonito	68	7	598	46	304	17	10	(11)	9	(11)
Bowfin					25	1	20	(11)		
Buffalofish									129	7
Butterfish	1,549	193	4,089	320	6,113	268	113	3	22	1
Cabio					3	(11)	(11)	(11)	23	1
Carp (German)	14	2	600	94	661	48	757	41		
Catfish and bullheads	1	(11)	221	19	1,009	58	3,830	161	3,472	151
Cero and kingfish							2,652	137	1,327	70
Cigarfish									116	3
Cod	90,336	2,956	4,874	233	17	(11)	(11)	(11)		
Crappie							392	28	630	19
Crevalle							215	7	86	3
Croaker			3,358	129	25,252	711	6,842	105	398	18
Cusk	3,230	91								
Drum, black			35	1	253	4	141	4	1,269	53
Drum, red			18	(11)	130	2	450	16	2,610	216
Eels	845	96	823	104	447	53	93	6		
Flounders	50,274	2,259	10,520	609	700	46	538	30	265	26
Garfish							1	(11)	9	1
Gizzard shad					381	10	110	2		
Goldfish					3	(11)				
Grayfish	206	3	7	(11)						
Groupers							157	7	4,241	131
Grunts							46	2	36	1
Haddock	237,708	7,048	17,023	597	2	(11)				
Hake	17,506	322	627	16	12	(11)	(11)	(11)		
Halibut	4,257	643	10	4						
Harvestfish					747	27	782	20		
Herring, sea	70,555	475	238	7						
Hickory shad	10	1	19	1	256	12	501	29		
Hog-choker					24	1				
Hogfish							3	(11)	2	(11)
Jewfish							17	1	136	7
King whiting	3	(11)	101	16	126	9	1,274	56	191	8
Ladyfish							3	(11)	359	9
Mackerel	42,722	2,186	2,946	196	21	2				
Menhaden	5,175	73	39,891	162	150,493	1,435	150,843	584	5,857	39
Moonfish							(11)	(11)	1	(11)
Mullet and mullet roe			29	2	137	9	9,376	420	26,447	1,113
Mummichog			9	1						
Muttonfish							594	31	260	11
Paddlefish and paddlefish roe									3	(11)
Perch, white	12	2	198	24	1,057	95	458	30		
Perch, yellow	(11)	(11)	64	9	311	33	175	12		
Permit							4	(11)	33	1
Pigfish					142	8	374	9	56	2
Pike (jacks) and pickerel	(11)	(11)	1	(11)	89	20	21	2		
Pilotfish			4	(11)						
Pinfish					1	(11)	179	5	23	1
Pollock	11,040	224	126	6			(11)	(11)		
Pompano			1	(11)	5	1	292	79	441	88
Porgies							22	1	97	3
Porkfish									1	(11)
Salmon: Atlantic	31	6								
Scup	2,859	191	3,504	221	447	31				
Sea bass	229	23	2,370	205	106	8	818	62	30	3
Sea robin	482	4	53	1	50	(11)				
Shad	346	38	952	234	7,364	1,637	4,447	817		
Sharks	145	9	64	2	17	1	6	(11)	232	3
Sheepshead (salt water)					(11)	(11)	99	5	780	44
Sheepshead (fresh water)									7	(11)
Silversides			63	5						
Skates	1,058	14	88	3	24	(11)				
Smelt	903	188	(11)	(11)						

[10] Includes the catch of fish taken in Lake Okeechobee, Fla.
[11] Less than 500 pounds or dollars.

Fisheries of the United States and Alaska—Continued

CATCH: BY SECTIONS—Continued

[Expressed in thousands of pounds and thousands of dollars; that is, 000 omitted]

Species	New England, 1928		Middle Atlantic, 1926		Chesapeake, 1925		South Atlantic, 1928		Gulf,[10] 1928	
FISH—continued	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Snapper, mangrove							90	5	186	7
Snapper, red							72	7	10,391	86[illegible]
Snook							251	12	601	35
Spanish mackerel			14	2	128	17	2,250	151	3,352	229
Spot	5	(11)	1,758	108	1,977	100	3,280	77	180	7
Squeteague	114	16	9,401	601	13,925	669	6,404	420	5,340	564
Striped bass	57	9	197	48	2,235	392	508	72		
Sturgeon and sturgeon roe	4	1	23	8	93	28	34	5	26	4
Sucker	126	11	194	28	8	(11)	16	1		
Sunfish					8	(11)	478	19	98	3
Swellfish			13	(11)	35	(11)				
Swordfish	4,366	779	61	11						
Tang									(11)	(11)
Tautog	395	33	82	7	3	(11)				
Ten pounder									2	(11)
Thimble-eyed mackerel			122	5	19	1				
Tilefish			1,802	111						
Tomcod and tomcod roe	27	1	58	3	18	(11)				
Tripletail					(11)	(11)	2	(11)	9	1
Tuna	286	17	144	12			(11)	(11)	1	(11)
Turbot									(11)	(11)
White bait	(11)	(11)	18	1						
Whiting	8,378	92	7,521	156	114	2	(11)	(11)		
Yellowtail							89	6	125	9
Miscellaneous fish	1,170	30	637	16	6	(11)	12	1	45	(11)
Total	561,104	18,104	119,021	4,648	241,221	6,092	210,132	3,757	71,375	3,842
SHELLFISH, ETC.										
Clams:										
Hard	2,232	736	1,277	626	1,190	469	377	68	751	49
Cockle	10	3								
Surf or skimmers			59	15						
Soft	5,470	473	409	81						
Razor	38	8								
Conchs									16	1
Crabs:										
Stone							35	4	77	12
Soft	1	(11)	163	48	3,748	422	629	96	253	65
Hard	3,754	92	231	14	25,853	827	1,553	44	4,247	135
King			2,888	13						
Crawfish					(11)	(11)				
Lobsters:										
Common	11,604	3,414	1,119	331						
Spiny							367	29	197	15
Mussels	130	1	257	11						
Octopus							3	1		
Oysters: Eastern	9,373	1,883	39,511	6,171	60,264	6,022	10,588	428	34,942	1,943
Periwinkles	19	3								
Scallops:										
Sea	475	163	1,115	284					2	1
Bay	1,278	577	300	92	361	74	1,394	126	14	5
Shrimp	1	1	43	4	1	(11)	33,310	1,458	82,170	3,093
Squid	7,928	157	1,576	100	454	26				
Frogs			2	(11)						
Sponges									554	851
Terrapin			1	1	10	6	45	16	56	21
Turtles			28	3	4	(11)	7	(11)	30	2
Miscellaneous shellfish, etc	181	5	12	14	100	10				
Total	42,494	7,516	48,991	7,808	91,985	7,856	48,308	2,270	123,309	6,193
Grand total	603,598	25,620	168,012	12,456	333,206	13,948	258,440	6,027	194,684	10,035

[11] Less than 500 pounds or dollars.
[10] Includes the catch of fish taken in Lake Okeechobee, Fla.

Fisheries of the United States and Alaska—Continued

CATCH: BY SECTIONS—Continued

[Expressed in thousands of pounds and thousands of dollars; that is, 000 omitted]

Species	Pacific, 1928		Mississippi River and tributaries, 1922		Lakes,[12] 1928		Alaska, 1929		Total for the various years	
FISH	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Albacore	283	42							318	43
Alewives									40,843	507
Amberjack									29	2
Anchovies	357	4							357	4
Angelfish and spadefish									108	4
Barracuda	6,452	506							6,468	506
Black bass			74	11					826	98
Bluefish									3,048	402
Blue pike					4,843	425			4,843	425
Blue runner or hardtail									568	17
Bonito	2,088	68							3,077	138
Bowfin			190	6					235	7
Buffalofish			17,267	1,014					17,396	1,021
Butterfish									11,886	785
Burbot					584	15			584	15
Cabio									26	1
Carp (German)	727	25	18,338	872	1,242	60			22,339	1,142
Catfish and bullheads	458	64	8,093	713	503	49			17,587	1,215
Cero and kingfish									3,979	207
Chubs					5,030	499			5,030	499
Chubs (tullibee)					220	11			220	11
Cigarfish									116	3
Cisco					618	81			618	81
Cod	[13]17,130	294					2,278	15	114,635	3,498
Crappie			512	49					1,534	96
Crevalle									301	10
Croaker									35,850	963
Cusk									3,230	91
Dolly Varden trout							73	8	73	8
Drum, black									1,698	62
Drum, red									3,208	234
Eels	(11)	(11)	16	1					2,224	260
Flounders	13,332	722					1	(11)	75,630	3,692
Garfish									10	1
Gizzard shad									491	12
Goldfish									3	(11)
Grayfish	627	13							840	16
Groupers									4,398	138
Grunts									82	3
Haddock									254,733	7,645
Hake	109	2							18,254	340
Halibut	12,729	1,476					41,619	4,423	58,615	6,546
Hardhead	62	7							62	7
Harvestfish									1,529	47
Herring, lake					14,937	542			14,937	542
Herring, sea	2,676	27					153,106	1,148	226,575	1,657
Hickory shad									786	43
Hog-choker									24	1
Hogfish									5	(11)
Horse mackerel	540	18							540	18
Jewfish									153	8
Kingfish (California)	442	12							442	12
King whiting									1,695	89
Ladyfish									362	9
Lake trout					9,417	1,569			9,417	1,569
"Lingcod"	1,908	71					61	1	1,969	72
Mackerel	35,262	617							80,951	3,001
Menhaden									352,259	2,293
Moon-eye			3	(11)					3	(11)
Moonfish									1	(11)
Mullet and mullet roe	83	9							36,072	1,553
Mummichog									9	1
Muttonfish									854	42
Paddlefish and paddlefish roe			1,411	163					1,414	163
Perch, white	315	17							2,040	168
Perch, yellow			22	2	5,784	404			6,356	460
Permit									37	1
Pigfish									572	119

[11] Less than 500 pounds or dollars.
[12] Figures are for 1928 except those for shellfish, etc., which are for 1922.
[13] Dry salted cod have been converted to round weight.

Fisheries of the United States and Alaska—Continued

CATCH: BY SECTIONS—Continued

[Expressed in thousands of pounds and thousands of dollars; that is, 000 omitted]

Species	Pacific, 1928		Mississippi River and tributaries, 1922		Lakes,[12] 1928		Alaska, 1929		Total for the various years	
FISH—continued	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Pike (jacks) and pickerel			20	2	531	28			662	52
Pilchard	420, 270	2, 324							420, 270	2, 324
Pilotfish									4	(11)
Pinfish									203	6
Pollock									11, 166	230
Pompano	30	4							769	172
Porgies									119	4
Porkfish									1	(11)
Quillback			765	59					765	59
Rock bass	626	44	3	(11)					629	44
Rockfishes	7, 111	335					1	(11)	7, 112	335
Sablefish	3, 532	160					694	23	4, 226	183
Salmon:										
Atlantic									31	6
Pacific—										
King, chinook or spring	33, 917	4, 674					15, 188	589	49, 105	5, 263
Red or sockeye	4, 824	913					155, 116	4, 633	159, 940	5, 546
Coho or silver	18, 524	1, 253					17, 278	418	35, 802	1, 671
Humpback or pink	1, 261	43					170, 467	3, 984	171, 728	4, 027
Chum or keta	22, 366	696					84, 552	1, 218	106, 918	1, 914
Sauger pike			5	1	1, 596	132			1, 601	133
Sculpin	100	10							100	10
Scup									6, 810	443
Sea bass	382	19							3, 935	320
Sea bass, white (California)	1, 281	165							1, 281	165
Sea robin									585	5
Shad	3, 949	119							17, 058	2, 845
Sharks									464	15
Sheepshead (salt-water)									879	49
Sheepshead (fresh-water)			5, 261	290	2, 934	81			8, 202	371
Sheepshead (Pacific coast)	373	16							373	16
Silversides									63	5
Skates	461	9							1, 631	26
Skipjack	15, 815	562							15, 815	562
Smelt	2, 341	88					8	1	3, 252	277
Snapper, mangrove									276	12
Snapper, red									10, 463	867
Snook									852	47
Spanish mackerel									5, 744	399
Splittail	11	1							11	1
Spot									7, 200	292
Squawfish	4	(11)							4	(11)
Squeteague									35, 184	2, 270
Steelhead trout	3, 446	314					48	4	3, 494	318
Striped bass	497	76							3, 494	597
Sturgeon and sturgeon roe	173	15	11	1	30	14			394	76
Sturgeon, shovel-nosed			229	23					229	23
Sucker	1	(11)	700	63	3, 995	191			5, 040	294
Sunfish			375	25					959	47
Swellfish									48	(11)
Swordfish	426	51							4, 853	841
Tang									(11)	(11)
Tautog									480	40
Ten pounder									2	(11)
Thimble-eyed mackerel									141	6
Tilefish									1, 802	111
Tomcod and tomcod roe	12	(11)							115	4
Tripletail									11	1
Tuna	13, 701	823							14, 132	852
Turbot									(11)	(11)
White bass			65	5	286	19			351	24
White bait	135	9							153	10
Whitefish	222	14			6, 891	1, 335			7, 113	1, 349
Whiting									16, 013	250
Yellow bass			8	1					8	1

[11] Less than 500 pounds or dollars.
[12] Figures are for 1928 except those for shellfish, etc., which are for 1922.

Fisheries of the United States and Alaska—Continued

CATCH: BY SECTIONS—Continued

[Expressed in thousands of pounds and thousands of dollars; that is, 000 omitted]

Species	Pacific, 1928		Mississippi River and tributaries, 1922		Lakes,[12] 1928		Alaska, 1929		Total for the various years	
FISH—continued	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Yellow pike			25	$4	2,926	$450			2,951	$454
Yellowfin tuna	32,251	$1,774							32,251	1,774
Yellowtail	2,684	139							2,898	154
Miscellaneous fish	219	8	73	5	1,001	56			3,163	116
Total	686,525	18,652	53,466	3,310	63,368	5,961	640,490	$16,465	2,646,702	80,831
SHELLFISH, ETC.										
Abalone	421	85							421	85
Clams:										
Hard	215	32							6,042	1,980
Cockle	3	2							13	5
Surf or skimmers									59	15
Soft	25	10							5,904	564
Razor	1,636	318					704	41	2,378	367
Pismo	31	10							31	10
Mixed	16	7							16	7
Conchs									16	1
Crabs:										
Stone									112	16
Soft									4,794	631
Hard	5,589	419					399	36	41,626	1,567
King									2,888	13
Crawfish	158	20	8	1	82	3			248	24
Lobsters:										
Common									12,723	3,745
Spiny	1,077	190							1,641	234
Mussels	(11)	(11)							387	12
Mussel shells, fresh-water			51,768	1,051	6,246	218			58,014	1,269
Octopus	70	4							73	5
Oysters:										
Eastern	146	63							154,824	16,510
Western	619	315							619	315
Pearls				46		9				55
Periwinkles									19	3
Scallops:										
Sea									1,592	448
Bay	18	5							3,365	879
Shrimp	2,317	43	147	15			905	40	118,894	4,654
Slugs				55		7				62
Squid	1,352	41							11,310	324
Frogs			232	20					234	20
Sponges									554	851
Terrapin	(11)	(11)							112	44
Turtles	6	(11)	97	3	1	(11)			173	8
Miscellaneous shellfish, etc	6	(11)	16	3	3	(11)			318	32
Total	13,705	1,564	52,268	1,194	6,332	237	2,008	117	429,400	34,755
WHALE PRODUCTS[13]										
Oil, sperm							358	18	358	18
Oil, whale	4,881	296					5,893	413	10,774	709
Whale meal and scrap							2,622	69	2,622	69
Other whale products							52	2	52	2
Total	4,881	296					8,925	502	13,806	798
Grand total	705,111	20,512	105,734	4,504	69,700	6,198	651,423	17,084	3,089,908	116,384

[11] Less than 500 pounds or dollars.
[12] Figures are for 1928, except those for shellfish, etc., which are for 1922.
[13] The weight of the whales caught was not determined; therefore, the weight of the manufactured products is shown.

Fisheries of the United States and Alaska—Continued

CATCH: BY STATES[14]

[Expressed in thousands of pounds and thousands of dollars; that is, 000 omitted]

States	Marine and coastal rivers		Mississippi River and tributaries		Lakes[15]		Total	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Alabama	14,466	587	1,243	28			15,709	615
Arkansas			22,795	760			22,795	760
California	588,647	10,325					588,647	10,325
Connecticut	72,198	3,297					72,198	3,297
Delaware	33,258	1,030					33,258	1,030
Florida	128,161	6,081			3,677	169	131,838	6,250
Georgia	42,069	866					42,069	866
Illinois			22,598	1,079	578	78	23,176	1,157
Indiana			12,577	437	1,115	93	13,692	530
Iowa			6,761	326			6,761	326
Kansas			615	26			615	26
Kentucky			2,893	167			2,893	167
Louisiana	69,507	3,478	10,486	573			79,993	4,051
Maine	123,326	4,231					123,326	4,231
Maryland	56,978	4,863					56,978	4,863
Massachusetts	380,169	15,648					380,169	15,648
Michigan					26,193	2,746	26,193	2,746
Minnesota			5,660	230	9,977	445	15,637	675
Mississippi	30,701	1,060	3,328	191			34,029	1,251
Missouri			1,566	104			1,566	104
Nebraska			135	15			135	15
New Hampshire	239	46					239	46
New Jersey	73,299	6,254					73,299	6,254
New York	60,720	5,129			1,902	251	62,622	5,380
North Carolina	141,899	2,629					141,899	2,629
Ohio			702	30	16,865	1,160	17,567	1,190
Oklahoma			363	31			363	31
Oregon	27,474	2,686					27,474	2,686
Pennsylvania	735	43	49	2	1,958	253	2,742	298
Rhode Island	27,666	2,398					27,666	2,398
South Carolina	7,432	317					7,432	317
South Dakota			101	4			101	4
Tennessee			5,494	188			5,494	188
Texas	15,212	875	184	19			15,396	894
Virginia	276,228	9,085					276,228	9,085
Washington	88,990	7,501					88,990	7,501
West Virginia			95	8			95	8
Wisconsin			8,089	286	11,112	1,172	19,201	1,458
Alaska	651,423	17,084					651,423	17,084
Total	2,910,797	105,513	105,734	4,504	73,377	6,367	3,089,908	116,384

TRANSPORTING UNITS: BY SECTIONS

Items	New England, 1928	Middle Atlantic, 1926	Chesapeake, 1925	South Atlantic, 1928	Gulf, 1928	Pacific, 1928	Mississippi River and tributaries, 1922	Lakes, 1922	Alaska, 1929	Total for the various years
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Persons engaged	382	89	985	233	85	356	30	162	1,716	4,038
Vessels:										
Steam	4	1	1			1		6	24	37
Net tonnage	136	36	76			331		126	32,415	33,120
Motor	161	62	433	69	35	121	13	97	390	1,381
Net tonnage	1,990	924	5,180	780	481	3,243	214	831	14,261	27,904
Sail	3		89	43	2	4			2	143
Net tonnage	271		2,907	412	23	1,520			3,555	8,688
Total vessels	168	63	523	112	37	126	13	103	416	1,561
Total net tonnage	2,397	960	8,163	1,192	504	5,094	214	957	50,231	69,712

[14] Statistics for the New England States are for 1928; Middle Atlantic States, 1926; Chesapeake Bay States, 1925; South Atlantic States, 1928; Gulf States, 1928; Pacific Coast States, 1928; Mississippi River and tributaries, 1922; Lake States, 1928, except that the fisheries for shellfish, etc., are for 1922; and Alaska, 1929.

[15] Includes Lake Ontario, Lake Erie, Lake Huron, Lake Michigan, Lake Superior, Rainy Lake, Namakan Lake, Lake of the Woods, Lake Okeechobee, and several mussel-bearing streams tributary to Lakes Erie and Michigan.

CANNED FISHERY PRODUCTS AND BY-PRODUCTS TRADE

The output of canned fishery products and by-products in the United States and Alaska in 1929 was valued at $124,832,711, which was greater than that for any year for which there are records. Larger packs were reported for almost every commodity. Of the total, canned products comprised $101,065,055 and by-products $23,767,656, an increase of 5 per cent in the value of canned products and 60 per cent in the value of by-products when compared with the respective values of the same groups for the previous year. (The value of by-products for 1929 is not comparable directly with that for 1928, since statistics of the output of fresh-water mussel-shell products were not obtained in the former year.)

Fishery products were canned at 497 establishments in the United States and Alaska in 1929. The combined output of these canneries amounted to 17,310,238 standard cases. The net weight of the products canned amounted to 689,446,781 pounds.

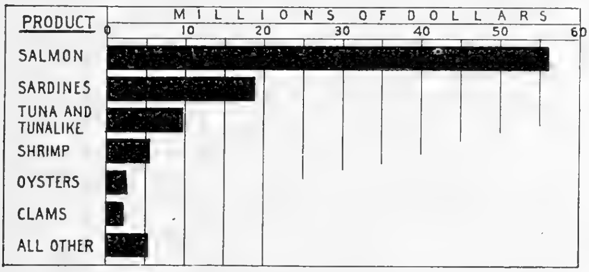

FIGURE 5.—Value of canned fishery products in the United States and Alaska, 1929

Canned fishery products or by-products were prepared in 28 States and Alaska in 1929. Alaska ranked first in value of these products, accounting for 35 per cent of the total. Salmon was the leading product canned there. California with her important sardine canning industries ranked second with 24 per cent of the total value; and Washington, with a valuable salmon canning industry, ranked third with 9 per cent of the total value. Maine, where canned sardines are the most important commodity, ranked fourth with 7 per cent of the total value. Considering the output by geographical sections, the Pacific coast and Alaska accounted for 72 per cent of the total value of canned products and by-products.

Canned fishery products and by-products of the United States and Alaska, 1929

SUMMARY OF PRODUCTION: BY COMMODITIES

Products	Number of plants	Standard cases	Pounds	Value
Canned products:				
Salmon—				
United States	52	1, 620, 523	77, 785, 104	$15, 616, 312
Alaska	156	5, 370, 159	257, 767, 632	40, 469, 385
Sardines—				
Maine and Massachusetts	38	2, 025, 801	50, 645, 025	6, 897, 946
California	31	3, 831, 215	183, 898, 320	11, 996, 997
Tuna and tunalike fishes	17	1, 504, 306	36, 103, 344	9, 873, 453
Mackerel	21	602, 283	28, 909, 584	2, 515, 742

Canned fishery products and by-products of the United States and Alaska, 1929—Continued

SUMMARY OF PRODUCTION: BY COMMODITIES—Continued

Products	Number of plants	Standard cases	Pounds	Value
Canned products—Continued.				
Alewives	23	68,445	3,285,360	$246,773
Alewife roe	32	28,819	1,383,312	188,374
Shad	14	26,153	1,255,344	122,117
Shad roe	12	2,732	131,136	91,379
Miscellaneous fish, caviar, roe, and eggs	32	231,157	11,095,536	2,022,534
Oysters	61	519,145	7,787,175	2,732,478
Clam products	71	554,639	[1] 13,612,185	2,548,472
Shrimp	76	909,949	15,071,948	5,528,792
Crabs	4	1,151	55,248	30,530
Miscellaneous shellfish	7	13,761	660,528	183,771
Total	[2] 497	17,310,238	689,446,781	101,065,055
By-products—			*Quantity*	
Oyster-shell products ... tons			334,766	2,524,499
Fresh-water mussel-shell products				6,144,515
Scrap, meal, etc. ... tons			142,681	6,801,362
Marine animal oils ... gallons			15,353,057	6,801,619
Miscellaneous by-products				1,495,661
Total				23,767,656
Grand total				124,832,711

[1] "Cutout" or "drained" weights of can contents are included for whole and minced clams and gross can contents for chowder, soup, bouillon, broth, juice, and cocktail.
[2] Exclusive of duplication.

VALUE OF PRODUCTION: BY STATES

States	Canned products	By-products [3]	Total
Maine	7,984,855	$331,537	$8,316,392
Massachusetts, Rhode Island, and Connecticut	1,893,218	2,321,005	4,214,223
New York and New Jersey	632,983	1,539,975	2,172,958
Pennsylvania and Delaware		495,275	495,275
Maryland	401,589	388,335	789,924
Virginia	221,730	1,482,301	1,704,031
North Carolina	192,420	835,968	1,028,388
South Carolina	861,166	154,197	1,015,363
Georgia and Florida	1,535,517	1,230,122	2,765,639
Alabama	385,256	39,171	424,427
Mississippi	2,256,426	206,550	2,462,976
Louisiana	2,713,029	1,194,742	3,907,771
Texas, Indiana, Wisconsin, and Minnesota	430,559	220,335	650,894
Michigan, Missouri, and Kentucky		65,730	65,730
Iowa		4,473,650	4,473,650
Washington	11,547,504	126,830	11,674,334
Oregon	4,798,789	50,200	4,848,989
California	24,536,953	5,897,059	30,434,012
Alaska	40,673,061	2,714,674	43,387,735
Total	101,065,055	23,767,656	124,832,711

[3] Including menhaden and fresh-water mussel-shell products.

Value of canned fishery products and by-products of the United States and Alaska, 1921 to 1929

Year	Canned products	By-products (including menhaden)	Total	Year	Canned products	By-products (including menhaden)	Total
1921	$46,634,706	$8,351,827	$54,986,533	1926	$86,193,240	$12,133,110	$98,326,350
1922	60,464,947	11,390,693	71,855,640	1927	81,384,133	12,793,256	94,177,389
1923	72,445,205	12,634,590	85,079,795	1928	95,871,855	14,880,956	110,752,811
1924	72,164,589	10,308,990	82,473,579	1929	101,065,055	23,767,656	124,832,711
1925	80,577,138	14,600,198	95,177,336				

CANNED PRODUCTS

The value of fishery products canned in 1929 was 5 per cent greater than in the previous year. Salmon was the most important item and contributed 55 per cent to the total value. Sardines were next with 19 per cent and tuna followed with 10 per cent. The remainder of the total value was made up mainly by shrimp, oysters, clam products, and mackerel.

Pack of canned fishery products, standard cases, 1921 to 1929

Year	Salmon						Sardines: Maine and Massachusetts	
	Pacific Coast States		Alaska		Total			
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Value*
1921	1,002,948	$9,234,425	2,596,826	$19,632,744	3,599,774	$28,867,169	1,399,507	$3,960,916
1922	733,246	8,633,524	4,501,652	29,787,193	5,234,898	38,420,717	1,869,719	5,750,109
1923	1,367,263	12,660,566	5,035,697	32,873,007	6,402,960	45,533,573	1,272,277	5,288,865
1924	958,662	9,394,467	5,294,915	33,007,135	6,253,577	42,401,602	1,899,925	7,191,026
1925	1,558,613	15,379,976	4,459,937	31,989,531	6,018,550	47,369,507	1,870,786	6,716,701
1926	835,738	10,139,302	6,652,882	46,080,004	7,488,620	56,219,306	1,717,537	6,727,388
1927	1,504,451	15,712,497	3,572,128	30,016,264	5,076,579	45,728,761	1,262,124	5,249,030
1928	842,903	9,254,258	6,083,903	45,383,885	6,926,806	54,638,143	2,055,763	8,076,546
1929	1,620,523	15,616,312	5,370,159	40,469,385	6,990,682	56,085,697	2,025,801	6,897,946

Year	Sardines: California		Tuna and tunalike fishes		Oysters	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*
1921	398,668	$2,346,446	549,150	$3,074,626	442,086	$2,179,271
1922	715,364	3,361,480	672,321	4,511,873	505,973	2,423,616
1923	1,100,162	4,607,931	817,836	6,914,760	524,544	2,720,073
1924	1,367,139	5,445,573	652,416	5,756,586	447,481	2,478,044
1925	1,714,913	6,380,617	1,102,471	8,499,080	654,755	3,721,159
1926	2,093,278	7,807,404	851,199	5,282,283	413,834	2,026,569
1927	2,563,146	9,268,784	1,255,818	8,368,227	447,297	2,367,949
1928	2,771,527	9,658,822	1,216,222	8,374,030	503,952	2,760,576
1929	3,831,215	11,996,997	1,504,306	9,873,453	519,145	2,732,478

Year	Shrimp		Clam products		Miscellaneous fishery products: Fish roe, caviar, and eggs	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*
1921	655,364	$3,804,781	[1]	$1,166,507	[1]	[1]
1922	579,797	3,064,087	[1]	1,716,365	[1]	[1]
1923	700,429	4,381,534	[1]	1,710,616	[1]	[1]
1924	718,517	4,608,950	[1]	2,161,389	[1]	[1]
1925	735,714	3,782,819	[1]	1,850,378	[1]	[1]
1926	732,365	4,122,092	[1]	2,004,650	[1]	[1]
1927	852,764	5,321,652	525,286	2,744,954	57,586	$477,415
1928	851,831	5,181,547	531,640	2,623,598	78,394	681,150
1929	909,949	5,528,792	554,639	2,548,472	46,501	502,040

Year	Miscellaneous fishery products						Grand total
	Other fish		Other shellfish		Total		
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*	*Value*
1921	[1]	[1]	[1]	[1]	[1]	$1,234,990	$46,634,706
1922	[1]	[1]	[1]	[1]	[1]	1,216,700	60,464,947
1923	[1]	[1]	[1]	[1]	[1]	1,287,853	72,445,205
1924	[1]	[1]	[1]	[1]	[1]	2,121,419	72,164,589
1925	[1]	[1]	[1]	[1]	[1]	2,256,877	80,577,138
1926	[1]	[1]	[1]	[1]	[1]	2,003,548	86,193,240
1927	236,579	$1,765,888	4,479	$91,473	298,644	2,334,776	81,384,133
1928	683,255	3,703,918	10,590	173,525	772,239	4,558,593	95,871,855
1929	913,088	4,684,879	14,912	214,301	974,501	5,401,220	101,065,055

[1] Not enumerated separately prior to 1927.

SALMON

In 1929, salmon were canned at 156 plants in Alaska, 36 in Washington, 15 in Oregon, and 1 in California. Compared with the previous year there was an increase of 3 plants in Alaska and 1 in Washington, and a decrease of 2 in Oregon and 1 in California. The combined output of the 208 plants amounted to 6,990,682

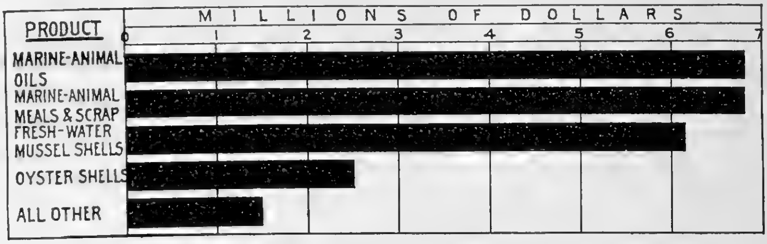

FIGURE 6.—Value of fishery by-products in the United States and Alaska, 1929

standard cases of forty-eight 1-pound cans valued at $56,085,697. Of the total, 1,620,523 cases valued at $15,616,312 were packed in the Pacific Coast States, and 5,370,159 cases valued at $40,469,385 in Alaska. The pack for the Pacific Coast States was 92 per cent greater than in the year previous due mainly to the larger pack in Puget Sound of humpback or pink salmon, as 1929 was a "good"

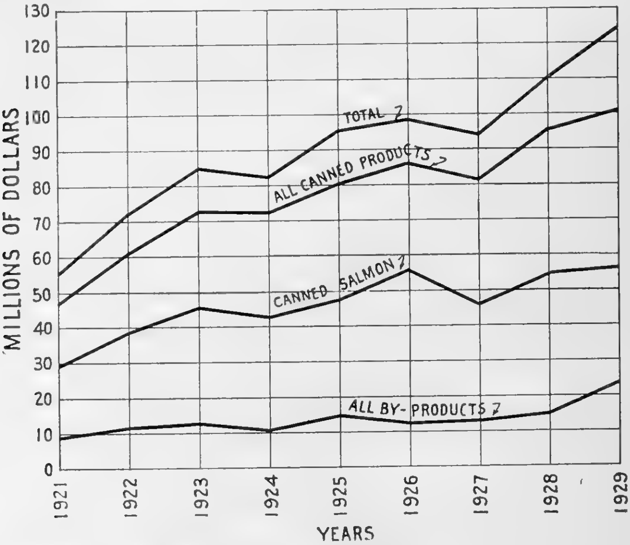

FIGURE 7.—Value of canned fishery products and by-products in the United States and Alaska, 1921 to 1929

year. Compared with 1927, the previous "good" year, there was an increase of 8 per cent in the pack. The pack in Alaska was 12 per cent less than in the previous year.

The world pack of canned salmon in 1929 amounted to 10,058,155 cases, which was a decrease of 6 per cent, as compared with that of the previous year. Of the total, 6,990,682 cases, or 70 per cent of the total, were packed in the United States and Alaska; 1,400,750 cases, or 14 per cent in British Columbia; 1,031,298 cases, or 10 per cent in Siberia; and 635,425 cases (estimated), or 6 per cent in Japan.

Compared with the pack in 1928, there was an increase of 1 per cent in the pack in the United States and Alaska, a decrease of 31 per cent in British Columbia, a decrease of 30 per cent in Siberia, and an increase of 190 per cent in Japan. Statistics of the pack in Siberia and Japan were obtained from the 1930 annual statistical number of the Pacific Fisherman.

Pack of canned salmon, Pacific Coast States and Alaska, 1929, standard cases

Products	Alaska							
	Southeast		Central		Western		Total	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Value*
King, chinook, or spring:								
1-pound tall	1, 382	$10, 924	6, 812	$57, 818	20, 785	$176, 135	28, 979	$244, 877
1-pound flat	5, 031	66, 741	14, 600	215, 026	7, 177	74, 885	26, 808	356, 652
½-pound flat	587	8, 713	14, 249	222, 842	1, 484	26, 712	16, 320	258, 267
Total	7, 000	86, 378	35, 661	495, 686	29, 446	277, 732	72, 107	859, 796
Red or sockeye:								
1-pound tall	102, 511	1, 073, 685	371, 875	3, 773, 115	1, 040, 079	10, 735, 352	1, 514, 465	15, 582, 152
1-pound flat	24, 194	286, 724	43, 991	539, 849	7, 141	79, 761	75, 326	906, 334
½-pound flat	36, 247	554, 968	38, 220	622, 898	25, 669	438, 073	100, 136	1, 615, 939
Total	162, 952	1, 915, 377	454, 086	4, 935, 862	1, 072, 889	11, 253, 186	1, 689, 927	18, 104. 425
Coho or silver:								
1-pound tall	88, 143	664, 565	66, 424	485, 214	2, 779	20, 151	157, 346	1, 169, 930
1-pound flat	4, 488	34, 919	2, 242	15, 997			6, 730	50, 916
½-pound flat	5, 216	55, 692	2, 664	27, 919			7, 880	83, 611
Total	97, 847	755, 176	71, 330	529, 130	2, 779	20, 151	171, 956	1, 304, 457
Humpback or pink:								
1-pound tall	1, 499, 761	8, 998, 967	1, 019, 834	6, 158, 172	3, 390	17, 720	2, 522, 985	15, 174, 859
1-pound flat	3, 894	27, 131	16	96			3, 910	27, 227
½-pound flat	38, 960	304, 108	5, 802	73, 162			44, 762	377, 270
Total	1, 542, 615	9, 330, 206	1, 025, 652	6, 231, 430	3, 390	17, 720	2, 571, 657	15, 579, 356
Chum or keta:								
1-pound tall	286, 832	1, 546, 498	496, 778	2, 638, 902	75, 941	402, 090	859, 551	4, 587, 490
½-pound flat	3, 965	26, 886	996	6, 975			4, 961	33, 861
Total	290, 797	1, 573, 384	497, 774	2, 645, 877	75, 941	402, 090	864, 512	4, 621, 351
Grand total	2, 101, 211	13, 660, 521	2, 084, 503	14, 837, 985	1, 184, 445	11, 970, 879	5, 370, 159	40, 469, 385

Products	United States						Grand total, Alaska and United States	
	Washington		Oregon and California		Total			
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Value*
King, chinook, or spring:								
1-pound tall	12, 975	$102, 450	8, 535	$47, 410	21, 510	$149, 860	50, 489	$394, 737
1-pound oval	3, 871	61, 377	2, 991	68, 793	6, 862	130, 170	6, 862	130, 170
1-pound flat	13, 394	213, 620	43, 180	656, 968	56, 574	870, 588	83, 382	1, 227, 240
½-pound oval	193	5, 790	316	9, 480	509	15, 270	509	15, 270
½-pound flat	66, 257	1, 224, 490	128, 045	2, 350, 834	194, 302	3, 575, 324	210, 622	3, 833, 591
Total	96, 690	1, 607, 727	183, 067	3, 133, 485	279, 757	4, 741, 212	351, 864	5, 601, 008
Red or sockeye:								
1-pound tall	2, 466	27, 619			2, 466	27, 619	1, 516, 931	15, 609, 771
1-pound flat	16, 420	197, 040			16, 420	197, 040	91, 746	1, 103, 374
½-pound flat	104, 136	1, 874, 448	6, 193	111, 474	110, 329	1, 985, 922	210, 465	3, 601, 861
Total	123, 022	2, 099, 107	6, 193	111, 474	129, 215	2, 210, 581	1, 819, 142	20, 315, 006

Pack of canned salmon, Pacific Coast States and Alaska, 1929, standard cases—Con.

Products	United States						Grand total, Alaska and United States	
	Washington		Oregon and California		Total			
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Value*
Coho or silver:								
1-pound tall	44, 098	$352, 784	7, 218	$57, 744	51, 316	$410, 528	208, 662	$1, 580, 458
1-pound oval	3, 443	48, 202			3, 443	48, 202	3, 443	48, 202
1-pound flat	31, 136	280, 224	19, 396	174, 564	50, 532	454, 788	57, 262	505, 704
½-pound flat	35, 132	407, 531	[1] 58, 355	718, 001	93, 487	1, 125, 532	101, 367	1, 209, 143
Total	113, 809	1, 088, 741	84, 969	950, 309	198, 778	2, 039, 050	370, 734	3, 343, 507
Humpback or pink:								
1-pound tall	618, 547	3, 958, 701			618, 547	3, 958, 701	3, 141, 532	19, 133, 560
1-pound flat	17, 610	112, 704			17, 610	112, 704	21, 520	139, 931
½-pound flat	91, 503	805, 226			91, 503	805, 226	136, 265	1, 182, 496
Total	727, 660	4, 876, 631			727, 660	4, 876, 631	3, 299, 317	20, 455, 987
Chum or keta:								
1-pound tall	185, 028	962, 146	42, 080	218, 816	227, 108	1, 180, 962	1, 086, 659	5, 768, 452
1-pound flat			347	1, 804	347	1, 804	347	1, 804
½-pound flat	23, 739	161, 425	10, 912	74, 202	34, 651	235, 627	39, 612	269, 488
Total	208, 767	1, 123, 571	53, 339	294, 822	262, 106	1, 418, 393	1, 126, 618	6, 039, 744
Steelhead:								
1-pound tall	89	712			89	712	89	712
1-pound flat	1, 103	8, 824	3, 073	24, 584	4, 176	33, 408	4, 176	33, 408
½-pound oval	1, 652	33, 040	1, 991	39, 820	3, 643	72, 860	3, 643	72, 860
½-pound flat	5, 680	84, 064	9, 419	139, 401	15, 099	223, 465	15, 099	223, 465
Total	8, 524	126, 640	14, 483	203, 805	23, 007	330, 445	23, 007	330, 445
Grand total	1, 278, 472	10, 922, 417	342, 051	4, 693, 895	1, 620, 523	15, 616, 312	6, 990, 682	56, 085, 697

[1] Includes a few cases packed in quarter-pound cans.

NOTE.—"Standard cases" represent the various-sized cases converted to the equivalent of forty-eight 1-pound cans to the case.

Pack of canned salmon in the Pacific Coast States, 1921 to 1929

Year	King, chinook, or spring		Red or sockeye		Coho or silver		Humpback or pink	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Value*
1921	335, 854	$4, 527, 711	104, 954	$1, 905, 647	111, 643	$806, 678	402, 846	$1, 732, 847
1922	314, 126	4, 572, 607	97, 927	1, 816, 901	204, 252	1, 533, 173	3, 551	18, 546
1923	384, 705	5, 790, 419	105, 336	1, 955, 549	245, 548	1, 608, 627	445, 175	2, 211, 742
1924	349, 014	4, 599, 759	85, 800	1, 478, 698	231, 139	1, 774, 078	12, 778	79, 436
1925	432, 638	5, 990, 019	118, 387	2, 065, 975	307, 567	3, 313, 060	551, 375	3, 152, 342
1926	349, 600	5, 281, 404	75, 711	1, 474, 722	228, 141	2, 223, 499	2, 608	19, 609
1927	405, 319	6, 192, 368	123, 826	2, 170, 385	210, 537	2, 212, 763	586, 598	3, 865, 797
1928	282, 867	4, 645, 366	73, 204	1, 075, 826	152, 137	1, 344, 796	6, 101	45, 464
1929	279, 757	4, 741, 212	129, 215	2, 210, 581	198, 778	2, 039, 050	727, 660	4, 876, 631

Year	Chum or keta		Steelhead		Total	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*
1921	35, 132	$127, 659	12, 519	$133, 883	1, 002, 948	$9, 234, 425
1922	87, 583	365, 303	25, 797	326, 994	733, 246	8, 633, 524
1923	154, 342	769, 839	32, 157	324, 390	1, 367, 263	12, 660, 566
1924	247, 858	1, 192, 156	32, 073	270, 340	958, 662	9, 394, 467
1925	133, 368	641, 310	15, 278	217, 270	1, 558, 613	15, 379, 976
1926	148, 732	758, 843	30, 946	381, 225	835, 738	10, 139, 302
1927	145, 356	852, 120	32, 815	419, 064	1, 504, 451	15, 712, 497
1928	309, 536	1, 880, 405	19, 058	262, 401	842, 903	9, 254, 258
1929	262, 106	1, 418, 393	23, 007	330, 445	1, 620, 523	15, 616, 312

NOTE.—Shown in standard cases of forty-eight 1-pound cans.

Pack of canned salmon in Alaska, 1921 to 1929

Year	King, chinook, or spring		Red or sockeye		Coho or silver	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*
1921	44, 994	$459, 897	1, 765, 798	$15, 841, 404	106, 555	$600, 140
1922	30, 660	247, 673	2, 070, 658	19, 135, 696	175, 993	962, 790
1923	38, 343	328, 270	1, 859, 496	17, 253, 792	164, 107	943, 318
1924	33, 648	299, 009	1, 447, 895	13, 803, 932	183, 601	1, 254, 551
1925	49, 978	595, 041	1, 059, 676	13, 904, 599	161, 010	1, 565, 759
1926	52, 476	544, 246	2, 157, 087	21, 328, 739	202, 527	1, 700, 563
1927	70, 391	791, 653	1, 320, 195	15, 954, 485	253, 044	2, 153, 956
1928	54, 159	602, 808	1, 948, 094	18, 333, 792	298, 623	2, 125, 289
1929	72, 107	859, 796	1, 689, 927	18, 104, 425	171, 956	1, 304, 457

Year	Humpback or pink		Chum or keta		Total	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*
1921	423, 984	$1, 788, 778	255, 495	$942, 525	2, 596, 826	$19, 632, 744
1922	1, 658, 423	7, 189, 494	565, 918	2, 251, 540	4, 501, 652	29, 787, 193
1923	2, 448, 129	11, 899, 956	525, 622	2, 447, 671	5, 035, 697	32, 873, 007
1924	2, 601, 283	12, 837, 346	1, 028, 488	4, 812, 297	5, 294, 915	33, 007, 135
1925	2, 110, 593	11, 137, 102	1, 078, 680	4, 787, 030	4, 459, 937	31, 989, 531
1926	3, 338, 349	17, 987, 527	902, 443	4, 518, 929	6, 652, 882	46, 080, 004
1927	1, 420, 775	8, 338, 690	507, 723	2, 777, 480	3, 572, 128	30, 016, 264
1928	2, 787, 242	18, 285, 530	995, 785	6, 036, 466	6, 083, 903	45, 383, 885
1929	2, 571, 657	15, 579, 356	864, 512	4, 621, 351	5, 370, 159	40, 469, 385

NOTE.—Shown in standard cases of forty-eight 1-pound cans.

Pack of canned salmon in the United States and Alaska, 1921 to 1929

Year	Pacific Coast States		Alaska		Total	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*
1921	1, 002, 948	$9, 234, 425	2, 596, 826	$19, 632, 744	3, 599, 774	$28, 867, 169
1922	733, 246	8, 633, 524	4, 501, 652	29, 787, 193	5, 234, 898	38, 420, 717
1923	1, 367, 263	12, 660, 566	5, 035, 697	32, 873, 007	6, 402, 960	45, 533, 573
1924	958, 662	9, 394, 467	5, 294, 915	33, 007, 135	6, 253, 577	42, 401, 602
1925	1, 558, 613	15, 379, 976	4, 459, 937	31, 989, 531	6, 018, 550	47, 369, 507
1926	835, 738	10, 139, 302	6, 652, 882	46, 080, 004	7, 488, 620	56, 219, 306
1927	1, 504, 451	15, 712, 497	3, 572, 128	30, 016, 264	5, 076, 579	45, 728, 761
1928	842, 903	9, 254, 258	6, 083, 903	45, 383, 885	6, 926, 806	54, 638, 143
1929	1, 620, 523	15, 616, 312	5, 370, 159	40, 469, 385	6, 990, 682	56, 085, 697

NOTE.—Shown in standard cases of forty-eight 1-pound cans.

SARDINES

In 1929 packs of sardines were reported by 37 plants in Maine, 1 in Massachusetts, and 31 in California. This is a decrease of 1 plant in Maine, an increase of 1 in Massachusetts, since none operated in this State in the previous year, and an increase of 3 plants in California. The production of sardines in Maine and Massachusetts amounted to 2,025,801 standard cases of one hundred ¼-pound cans valued at $6,897,946, which is a decrease of 1 per cent in quantity and 15 per cent in value as compared with the pack of the previous year. In California, the production amounted to 3,831,215 standard cases of forty-eight 1-pound cans valued at $11,996,997, which is an increase of 38 per cent in quantity and 24 per cent in value. The production in Maine was considerably above the average for the period 1921 to 1928, while that in California was over 1,000,000 cases greater than in any year during this period.

Pack of canned sardines, 1929

Sardines (herring)	Maine and Massachusetts		Sardines (pilchard)	California	
	Cases	*Value*	½-pound oval (48 cans):	*Cases*	*Value*
In olive oil: Quarters, ¼-pound (100 cans)	15,233	$88,850	In tomato sauce	24,055	$66,286
In cottonseed oil: Quarters, ¼-pound (100 cans)	1,586,072	5,509,175	In mustard	524	1,221
In mustard:			In olive oil	1,296	3,900
Quarters, ¼-pound (100 cans)	187,441	718,034	In other sauces and oils	378	759
Three-quarters, ¾-pound (48 cans)	146,678	472,436	1-pound oval (48 cans):		
In tomato sauce: Quarters, ¼-pound (100 cans)[1]	25,839	109,451	In tomato sauce	3,286,199	10,011,904
Total	1,961,263	6,897,946	In mustard	158,155	498,208
Total (standard cases)	2,025,801		In cottonseed oil	13,408	39,593
			In natural oil	3,840	11,947
			Soused	4,860	14,694
			In other sauces and oils	536	1,663
			¼-pound square (100 cans):		
			In tomato sauce	370	2,337
			In olive oil	10,623	101,898
			In other sauces and oils	399	2,472
			1-pound tall (48 cans):		
			In tomato sauce	4,654	11,080
			In natural oil	105,904	274,614
			In other sauces and oils	18,267	57,884
			Other sizes, various sauces and oils (standard cases)	216,333	896,537
			Total	3,849,801	11,996,997
			Total (standard cases)	3,831,215	

[1] Includes a few cases packed in 12-ounce cans, 48 to the case, which have been converted to the equivalent of quarter-size cans, 100 to the case.

NOTE.—"Standard cases" represent the various sized cases converted to the uniform basis of one hundred ¼-pound cans to the case of sardines (herring), and forty-eight 1-pound cans to the case of sardines (pilchard).

Pack of canned sardines, 1921 to 1929

Year	Maine and Massachusetts		California	
	Cases	*Value*	*Cases*	*Value*
1921	1,399,507	$3,960,916	398,668	$2,346,446
1922	1,869,719	5,750,109	715,364	3,361,480
1923	1,272,277	5,288,865	1,100,162	4,607,931
1924	1,899,925	7,191,026	1,367,139	5,445,573
1925	1,870,786	6,716,701	1,714,913	6,380,617
1926	1,717,537	6,727,388	2,093,278	7,807,404
1927	1,262,124	5,249,030	2,563,146	9,268,784
1928	[1] 2,055,763	8,076,546	2,771,527	9,658,822
1929	2,025,801	6,897,946	3,831,215	11,996,997

[1] Maine only. None packed in Massachusetts.

NOTE.—Shown in standard cases of one hundred ¼-pound cans for Maine and Massachusetts and forty-eight 1-pound cans for California.

TUNA AND TUNALIKE FISHES

In 1929, these fishes were canned at 17 plants in California. This is an increase of 1 plant as compared with those operating last year. The total pack was 1,504,306 standard cases of forty-eight ½-pound cans valued at $9,873,453. This is an increase of 24 per cent in quantity and 18 per cent in value as compared with the pack of the previous year. The pack was larger than in any year during the period 1921 to 1928.

Pack of canned tuna and tunalike fishes in California, 1929

Sizes	Albacore		Yellowfin		Bluefin	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*
¼-pound round (48 cans) [1]	11,422	$63,867	112,026	$471,121	16,041	$67,362
½-pound round (48 cans) [2]	106,903	1,100,775	416,905	2,704,197	65,078	409,510
1-pound round (48 cans) [3]	14,576	274,763	63,556	757,340	12,019	142,503
Flakes (standard cases)	6,729	38,652	61,397	261,295	4,938	20,693
Total	139,630	1,478,057	653,884	4,193,953	98,076	640,068
Total (standard cases)	148,496		661,427		102,074	

Sizes	Striped		Mixed yellowfin and bluefin [4]		"Tonno" [5]	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*
¼-pound round (48 cans) [1]	56,692	$215,622	5,587	$22,703	196,144	$833,570
½-pound round (48 cans) [2]	298,935	1,605,482	11,274	78,918	18,195	145,234
1-pound round (48 cans) [3]	22,055	222,079	1,252	16,276	929	13,316
Flakes (standard cases)	14,983	63,584	13,279	55,905		
Total	392,665	2,106,767	31,392	173,802	215,268	992,120
Total (standard cases)	386,374		29,851		118,125	

Sizes	Bonito		Yellowtail		Total	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*
¼-pound round (48 cans) [1]	9,921	$36,661	1,074	$2,953	408,907	$1,713,859
½-pound round (48 cans) [2]	19,657	103,933	5,655	26,564	942,602	6,174,613
1-pound round (48 cans) [3]	5,086	46,056	8,489	72,519	127,962	1,544,852
Flakes (standard cases)					101,326	440,129
Total	34,664	186,650	15,218	102,036	1,580,797	9,873,453
Total (standard cases)	34,789		23,170		1,504,306	

[1] Includes the pack in ½-pound cans, 96 to the case, ¼-pound cans, 96 and 100 to the case, and 5½-ounce glass jars, 48 to the case, which have been converted to the equivalent of ¼-pound round cans, 48 to the case.
[2] Includes the pack in ½-pound cans, 100 to the case, and 7-ounce glass jars, 24 to the case, which have been converted to the equivalent of ½-pound round cans, 48 to the case.
[3] Includes the pack in 4-pound cans, 12 to the case, which have been converted to the equivalent of 1-pound round cans, 48 to the case.
[4] Includes a few cases of mixed tuna of other varieties.
[5] Manufactured chiefly from bluefin tuna. All are packed in olive oil and the greater part marketed in square cans.

NOTE.—"Standard cases" represent the various sized cases converted to the equivalent of forty-eight ½-pound cans to the case.

Pack of canned tuna and tunalike fishes, 1921 to 1929

Year	Albacore		Bluefin and yellowfin tuna		Striped tuna		"Tonno"	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Value*
1921	456,152	$2,657,266	64,816	$306,486	27,972	$109,929		
1922	296,210	2,304,935	168,874	1,047,621	177,995	942,356	13,714	$139,067
1923	310,037	3,106,329	261,773	1,959,812	96,452	578,254	124,416	1,136,814
1924	416,820	4,024,509	65,941	455,048	43,159	239,198	97,304	861,861
1925	[1] 518,079	4,412,655	261,482	1,745,338	168,177	997,697	131,159	1,212,024
1926 [2]	61,197	471,502	287,699	1,718,744	290,278	1,525,146	137,720	1,209,041
1927	131,157	1,118,985	533,691	3,594,195	414,314	2,362,587	116,335	979,860
1928	105,722	1,027,289	[3] 743,536	4,976,855	201,816	1,098,822	126,959	1,068,299
1929	148,496	1,478,057	[3] 794,893	5,007,823	386,374	2,106,767	118,125	992,120

[1] Includes 27,489 cases of tuna flakes, valued at $120,637.
[2] Includes 25,353 cases of tuna flakes, valued at $102,129, which have been credited to the various species as packed.
[3] Includes a few cases of mixed tuna of other varieties.

Pack of canned tuna and tunalike fishes, 1921 to 1929—Continued

Year	Bonito		Yellowtail		Total	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*
1921			210	$945	549,150	$3,074,626
1922	10,810	$58,900	4,718	18,994	672,321	4,511,873
1923	15,099	77,906	10,059	55,645	817,836	6,914,760
1924	12,899	94,806	16,293	81,164	652,416	5,756,586
1925	10,090	61,207	13,484	70,159	1,102,471	8,499,080
1926 [2]	48,113	259,204	26,192	98,646	851,199	5,282,283
1927	18,587	111,253	41,734	201,347	1,255,818	8,368,227
1928	24,112	123,242	14,077	79,523	1,216,222	8,374,030
1929	34,789	186,650	23,170	102,036	1,504,306	9,873,453

[2] Includes 25,253 cases of tuna flakes, valued at $102,129, which have been credited to the various species as packed.

NOTE.—Shown in standard cases of forty-eight ½-pound cans.

MACKEREL

In 1929 mackerel were canned at 18 plants in California, and 3 plants in Massachusetts. An equal number of plants operated in California last year. However, there is a decrease of 1 plant in Massachusetts. The total production amounted to 602,283 standard cases of forty-eight 1-pound cans valued at $2,515,742. This is an increase of 51 per cent in quantity and 47 per cent in value as compared with the pack and its value for 1928. This is by far the largest pack of mackerel on record.

Pack of canned mackerel, 1929

Sizes	Massachusetts		California		Total	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*
8-ounce (48 cans)			[1] 46,871	$137,268	46,871	$137,268
14-ounce (24 cans)	[2] 22,473	$87,684			22,473	87,684
16-ounce (48 cans)			569,016	2,290,790	569,016	2,290,790
Total	22,473	87,684	615,887	2,428,058	638,360	2,515,742
Total (standard cases)	9,832		592,451		602,283	

[1] Includes a few cases packed in 8-ounce cans, 72 to the case, which have been converted to the equivalent of 8-ounce cans, 48 to the case.

[2] Includes a few cases packed in 8-ounce cans, 24 to the case, which have been converted to the equivalent of 14-ounce cans, 24 to the case.

NOTE.—"Standard cases" represent the various sized cases converted to the equivalent of forty-eight 1-pound cans to the case.

Pack of canned mackerel, 1928 and 1929

Year	Massachusetts		California		Total	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*
1928	10,382	$92,425	388,521	$1,621,595	398,903	$1,714,020
1929	9,832	87,684	592,451	2,428,058	602,283	2,515,742

NOTE.—Shown in standard cases of forty-eight 1-pound cans to the case.

ALEWIFE PRODUCTS

In 1929 alewives or alewife roe were canned at 9 plants in Maryland, 21 in Virginia, and 2 in North Carolina—a total of 32 plants or 4 more than in 1928. The output consisted of 68,445 standard cases of canned alewives valued at $246,773 and 28,819 cases of alewife roe valued at $188,374—a total of 97,264 standard cases of forty-eight 1-pound cans valued at $435,147. Considering the total production there was a decrease of 9 per cent in quantity and 1 per cent in value, as compared with that of the previous year. With the exception of the pack in 1928, that for 1929 was larger than the production during any year during the period from 1921 to 1928.

Pack of canned alewives and alewife roe, 1929

STANDARD CASES

Products	Maryland		Virginia and North Carolina		Total	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*
Alewives	37,181	$146,984	31,264	$99,789	68,445	$246,773
Alewife roe	9,302	69,739	19,517	118,635	28,819	188,374
Total	46,483	216,723	50,781	218,424	97,264	435,147

ACTUAL CASES

Products and sizes	Cases	Value	Products and sizes	Cases	Value
Alewives:			Alewife roe—Continued.		
8-ounce (48 cans)	4,242	$6,328	15 and 16 ounce (24 cans)	7,649	$25,572
15 and 16 ounce (48 cans)	46,320	152,920	17-ounce (24 cans)	20,903	64,257
17-ounce (24 cans)	14,561	23,742	18-ounce (24 cans)	3,266	9,612
18 and 19 ounce (24 cans)	22,310	63,783	19-ounce (24 cans)	4,800	22,670
Total	87,433	246,773	Total	53,964	188,374
Alewife roe:			Grand total	141,397	435,147
7½, 8, and 8½ ounce (48 cans)	13,859	53,110			
10-ounce (48 cans)	3,487	13,153			

NOTE.—"Standard cases" represent the various sized cases converted to the equivalent of forty-eight 1-pound cans to the case.

Pack of canned alewives and alewife roe, 1921 to 1929

Year	Alewives		Alewife roe		Total	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*
1921	156	$813	20,304	$157,841	20,460	$158,654
1922	489	1,994	18,099	137,514	18,588	139,508
1923	537	1,915	20,404	169,435	20,941	171,350
1924	1,550	5,118	41,642	332,245	43,192	337,363
1925	4,449	15,045	35,183	240,461	39,632	255,506
1926	19,920	65,405	33,886	201,278	53,806	266,683
1927	21,327	64,577	45,168	252,120	66,495	316,697
1928	50,674	150,878	56,392	288,592	107,066	439,470
1929	68,445	246,773	28,819	188,374	97,264	435,147

NOTE.—Shown in standard cases of forty-eight 1-pound cans.

SHRIMP

In 1929 shrimp were canned at 1 plant in North Carolina, 4 in South Carolina, 7 in Georgia, 10 in Florida, 4 in Alabama, 18 in Mississippi, 26 in Louisiana, and 6 in Texas, making a total of 76 plants, or 5 more than a year ago. The total pack amounted to 909,949 standard cases of 48 No. 1 cans (5-ounce cans, dry pack, and 5¾-ounce, wet pack), valued at $5,528,792. This is an increase of 7 per cent both in quantity and in value as compared with that for the previous year. Louisiana was by far the most important State in the production of canned shrimp accounting for 46 per cent of the total quantity and 45 per cent of the total value. The pack of shrimp during the year 1929 was larger than that for any year during the period 1921 to 1928.

Pack of canned shrimp, 1929

STANDARD CASES

States	Dry pack (in tins)		Wet pack (in tins)		Wet pack (in glass)[1]		Total	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Valu*
North and South Carolina	1, 689	$9, 315	48, 807	$268, 331			50, 496	$277, 646
Georgia	28, 291	183, 108	78, 858	458, 938			107, 149	642, 046
Florida	3, 504	19, 666	37, 997	219, 805	22, 389	$245, 349	63, 890	484, 820
Alabama	36, 366	203, 492	18, 848	106, 919			55, 214	310, 411
Mississippi	46, 918	255, 582	92, 015	509, 694	1, 374	15, 050	140, 307	780, 326
Louisiana	156, 975	967, 124	265, 840	1, 537, 174			422, 815	2, 504, 298
Texas	3, 889	24, 142	45, 389	277, 277			49, 278	301, 419
South Carolina, Georgia, Louisiana, and Texas					20, 800	227, 826	20, 800	227, 826
Total	277, 632	1, 662, 429	587, 754	3, 378, 138	44, 563	488, 225	909, 949	5, 528, 792

ACTUAL CASES

Sizes	Cases	Value	Sizes	Cases	Value
In tins, dry:			In glass, wet:		
No. 1, 4-ounce (48 cans)	21, 738	$98, 077	5¼-ounce (24 cans)	87, 883	$439, 748
No. 1, 4½-ounce (48 cans)	8, 932	55, 316	6¼-ounce (24 cans)	8, 814	48, 477
No. 1, 5-ounce (48 cans)	226, 832	1, 334, 213			
No. 1½, 8¼-ounce (24 cans)	29, 472	167, 798	Total		5, 528, 792
Other sizes (standard cases)	1, 056	7, 025			
In tins, wet:					
No. 1, 5¾-ounce (48 cans)	579, 105	3, 320, 613			
No. 1½, 9¾-ounce (24 cans)	4, 915	27, 922			
Other sizes (standard cases)	4, 482	29, 603			

[1] The pack of shrimp in glass for South Carolina, Georgia, Louisiana, and Texas has been grouped to avoid the disclosure of private enterprise.

NOTE.—"Standard cases" represent the various-sized cases converted to the equivalent of 48 No. 1, 5-ounce cans to the case in the dry pack, and 48 No. 1, 5¾-ounce cans to the case in the wet pack.

Pack of canned shrimp, 1921 to 1929

Year	Cases	Value	Year	Cases	Value
1921	655, 364	$3, 804, 781	1926	732, 365	$4, 122, 092
1922	579, 797	3, 064, 087	1927	852, 764	5, 321, 652
1923	700, 429	4, 381, 534	1928	851, 831	5, 181, 547
1924	718, 517	4, 608, 950	1929	909, 949	5, 528, 792
1925	735, 714	3, 782, 819			

NOTE.—Shown in standard cases of 48 No. 1 cans.

OYSTERS

In 1929 oysters were canned at 4 plants in Maryland, 3 in North Carolina, 11 in South Carolina, 5 in Georgia, 5 in Florida, 4 in Alabama, 21 in Mississippi, 7 in Louisiana, and 1 in Texas—a total of 61 plants, or 1 less than in 1928. The output of these plants amounted to 519,145 standard cases of forty-eight 5-ounce cans valued at $2,732,478. This is an increase of 3 per cent in quantity and a decrease of 1 per cent in value as compared with the pack and its value for the previous year. The pack for 1929 was somewhat larger than the average for the period 1921 to 1928. Mississippi and South Carolina accounted for 75 per cent of the total value of the production.

The pack during the spring period (January-May, 1929) amounted to 405,004 standard cases, valued at $2,131,138, and that during the fall period (September-December, 1929) amounted to 114,141 standard cases, valued at $601,340.

Pack of canned oysters, 1929

STANDARD CASES

States	Cases	Value	States	Cases	Value
Maryland	28,933	$184,866	Alabama	14,521	$74,845
North Carolina	19,852	97,102	Mississippi	286,186	1,469,104
South Carolina	105,139	580,680	Louisiana and Texas	36,434	184,429
Georgia	18,258	92,540			
Florida	9,822	48,912	Total	519,145	2,732,478

ACTUAL CASES

Sizes	Cases	Value	Sizes	Cases	Value
4-ounce (48 cans)	71,480	$329,124	10-ounce (24 cans)	73,401	$388,939
5-ounce (48 cans)	352,884	1,784,530	Other sizes (standard cases)	2,258	15,608
6-ounce (48 cans)	4,628	49,489			
8-ounce (24 cans)	34,829	164,788	Total		2,732,478

NOTE.—"Standard cases" represent the various-sized cases converted to the equivalent of 48 No. 1 5-ounce cans to the case.

Pack of canned oysters, 1921 to 1929

Year	Cases	Value	Year	Cases	Value
1921	442,086	$2,179,271	1926	413,834	$2,026,569
1922	505,973	2,423,616	1927	447,297	2,367,949
1923	524,544	2,720,073	1928	503,952	2,760,576
1924	447,481	2,478,044	1929	519,145	2,732,478
1925	654,755	3,721,159			

NOTE.—Shown in standard cases of 48 No. 1 5-ounce cans to the case.

CLAM PRODUCTS

In 1929 razor-clam products were canned at 15 plants in Washington, 5 in Oregon, and 8 in Alaska; hard clam products at 1 plant in Rhode Island, 2 in New York, 1 in New Jersey, 1 in South Carolina, 1 in Georgia, 1 in Florida, 6 in Washington, and 1 in Oregon; and soft clam products at 22 plants in Maine and 2 in Massachusetts—a total of 63 plants, or 9 more than a year ago. The total production amounted to 554,639 standard cases of 48 No. 1 cans, valued at $2,548,472, an increase of 4 per cent in quantity and a decrease of 3 per cent in value as compared with 1928. Considered according to varieties of clams the pack of razor-clam products amounted to 71,462 standard cases, valued at $619,594; hard clams, 299,941 standard cases, valued at $1,279,920; and soft clams, 183,236 standard cases, valued at $648,958. The value of the pack in 1929 was considerably larger than the average for the period 1921 to 1928.

Pack of canned clams and clam products, 1929

Items and States	Cases	Value
Razor clams (Washington, Oregon, and Alaska):		
Whole—		
No. 1, 5-ounce (48 cans)	7, 295	$70, 035
1-pound, 8-ounce (48 cans)	837	9, 557
No. 2, 10-ounce (24 cans)	239	2, 318
Other sizes (standard cases)	226	1, 678
Minced—		
½-pound flat, 4-ounce (48 cans)	50, 561	358, 819
No. 1, 5-ounce (48 cans)	17, 837	154, 833
No. 2, 10-ounce (24 cans)	2, 364	16, 110
Other sizes (standard cases)	122	780
Juice—		
No. 1, 10-ounce (48 cans)	1, 148	4, 135
No. 2, 20-ounce (24 cans)	443	1, 329
Total	81, 072	619, 594
Total (standard cases)	71, 462	
Hard clams (Rhode Island, New York, New Jersey, South Carolina, Georgia, Florida, Washington, and Oregon):		
Whole—		
No. 1, 5-ounce (48 cans)	504	2, 882
1-pound, 8-ounce (48 cans)	2, 873	20, 111
No. 2, 10-ounce (24 cans)	16, 293	73, 428
No. 10, 52-ounce (6 cans)	4, 820	57, 840
Other sizes (standard cases)	15, 623	57, 165
Minced—		
No. 1, 5-ounce (48 cans)	717	4, 365
Other sizes (standard cases)	6, 845	43, 644
Chowder—Various sizes (standard cases)	206, 439	833, 052
Juice—		
No. 1, 10-ounce (48 cans)	978	$3, 912
No. 2, 20-ounce (24 cans)	1, 977	6, 263
No. 10, 102-ounce (6 cans)	921	3, 229
Other sizes (standard cases)	1, 859	21, 850
Broth, soup, bouillon and cocktail—Various sizes (standard cases)	36, 668	152, 179
Total	296, 517	1, 279, 920
Total (standard cases)	299, 941	
Soft clams (Maine and Massachusetts):		
Whole—		
No. 1, 5-ounce (48 cans)	45, 290	196, 387
1-pound, 8-ounce (48 cans)	7, 199	50, 779
No. 2, 10-ounce (24 cans)	14, 113	54, 380
Other sizes (standard cases)	10, 160	19, 840
Chowder—		
No. 1, 10-ounce (48 cans)	38, 423	156, 352
No. 3, 33-ounce (24 cans)	26, 991	121, 723
Other sizes (standard cases)	6, 243	19, 632
Juice—		
7-ounce (48 cans)	966	7, 732
20-ounce (24 cans)	7, 029	12, 651
Other sizes (standard cases)	5, 247	9, 482
Total	161, 661	648, 958
Total (standard cases)	183, 236	
Grand total (standard cases)	554, 639	2, 548, 472

NOTE.—"Standard cases" represent the various sized cases converted to the equivalent of 48 No. 1, 5-ounce, cans to the case, for whole and minced clams; and 48 No. 1, 10-ounce, cans to the case, for other clam products.

Value of canned clams and clam products, 1921 to 1929

Year	Razor clams	Hard clams	Soft clams	Clam chowders, juices, etc.	Total
1921	$506, 591	$138, 699	$338, 775	$182, 442	$1, 166, 507
1922	876, 364	201, 270	327, 287	311, 444	1, 716, 365
1923	883, 535	194, 937	308, 560	323, 584	1, 710, 616
1924	863, 126	271, 911	459, 882	566, 470	2, 161, 389
1925	860, 002	218, 601	287, 073	484, 702	1, 850, 378
1926	795, 256	191, 044	279, 996	738, 354	2, 004, 650
1927	1, 046, 797	231, 526	270, 747	1, 195, 884	2, 744, 954
1928	936, 394	203, 959	318, 510	1, 164, 735	2, 623, 598
1929	614, 130	259, 435	321, 386	1, 353, 521	2, 548, 472

MISCELLANEOUS CANNED FISHERY PRODUCTS

In addition to those products discussed individually above, there were 274,954 standard cases of forty-eight 1-pound cans of miscellaneous canned fishery products, valued at $2,450,331. This is an increase of 3 per cent in quantity and 2 per cent in value as compared with the quantity and value of similar products canned during 1928. Among these products shad were canned at 14 plants; shad roe at 12 plants; finnan haddie at 5 plants; fish flakes at 6 plants; fish cakes, balls, etc., at 9 plants; other fish at 9 plants; other roe and caviar at 8 plants;

salmon eggs at 7 plants; crabs at 5 plants; and other shellfish at 6 plants.

Compared with the pack of a year ago, the pack of shad and shad roe, which amounted to 28,885 cases, valued at $213,496, increased 5 per cent in quantity and decreased 9 per cent in value; the pack of other fish and fish products, excluding roe and caviar, amounted to 216,207 cases, valued at $1,800,247—an increase of 3 per cent in quantity and 4 per cent in value. Other roe and caviar amounted to 10,622 cases, valued at $113,319—a decrease of 16 per cent in quantity and 22 per cent in value. Salmon eggs (for bait) amounted to 4,328 cases, valued at $108,968, a decrease of 18 per cent in quantity and 12 per cent in value. Crabs amounted to 1,151 cases, valued at $30,530—a decrease of 29 per cent in quantity and 31 per cent in value. Other shellfish amounted to 13,761 cases, valued at $183,771—an increase of 53 per cent in quantity and 42 per cent in value.

Pack of miscellaneous canned fishery products in the United States and Alaska, 1929, standard cases

Items	Cases	Value	Items	Cases	Value
Shad	26,153	$122,117	Other roe and caviar [2]	10,622	113,319
Shad roe	2,732	91,379	Salmon eggs (for bait)	4,328	108,968
Finnan haddie	1,030	15,557	Crabs	1,151	30,530
Fish flakes	56,236	570,391	Other shellfish [3]	13,761	183,771
Fish cakes, balls, etc	132,024	1,088,610			
Other fish [1]	26,917	125,689	Total	274,954	2,450,331

[1] Includes the pack of canned fillets, fish chowder, cat and dog food, bait herring, eels, and miscellaneous fish products.
[2] Includes the pack of roe and caviar from whitefish, sturgeon, salmon, and ground fish.
[3] Includes the pack of turtle products, terrapin products, mussels, abalone, squid, and clam cakes.

NOTE.—"Standard cases" represent the various sized cases converted to the equivalent of forty-eight 1-pound cans to the case.

Pack of canned shad and shad roe, 1921 to 1929

Year	Shad		Shad roe		Total	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*
1921	641	$2,455	38	$142	679	$2,597
1922	1,781	9,961	292	8,517	2,073	18,478
1923	2,162	37,165	536	16,288	2,698	53,453
1924	6,470	20,461	1,164	72,932	7,634	93,393
1925	12,569	53,875	2,430	100,571	14,999	154,446
1926	14,275	63,334	1,121	39,422	15,396	102,756
1927	11,569	61,842	767	21,890	12,336	83,732
1928	23,447	110,006	4,130	123,840	27,577	233,846
1929	26,153	122,117	2,732	91,379	28,885	213,496

NOTE.—Shown in standard cases of forty-eight 1-pound cans.

Value of canned crabs 1921 to 1929

Year	Value	Year	Value
1921	$115,800	1926	$25,222
1922	104,171	1927	26,988
1923	47,023	1928	44,536
1924	35,944	1929	30,530
1925	52,499		

BY-PRODUCTS

In 1929 the total value of by-products, including products of menhaden, whaling, and fresh-water mussel-shell industries, amounted to $23,767,656. This is an increase over the previous year's value of 60 per cent. However, statistics of the fresh-water mussel-shell products which amounted to $6,144,515 in 1929, were not obtained for 1928. Excluding mussel-shell products, the increase over a year ago amounted to 18 per cent. The scrap and meal group, and the marine animal oils group were the most valuable and each accounted for 29 per cent of the total value. Fresh-water mussel-shell products followed with 26 per cent, and oyster-shell products with 10 per cent. Miscellaneous by-products, which include herring skins and scales, shark skins and fins, fish flour, agar, kelp products, isinglass, pickled whale meat, and whalebone made up the remaining 6 per cent.

OILS

In 1929 the production of marine animal oils amounted to 15,353,057 gallons valued at $6,801,619, which is an increase of 26 per cent in quantity and 32 per cent in value when compared with the preceding year. Of the total production, 21 per cent consisted of menhaden oil, 42 per cent pilchard or sardine oil, and 23 per cent herring oil (from Maine and Alaska herring, and alewives). The production of whale and sperm oil amounted to 9 per cent of the total. The remaining 5 per cent consisted of oils from salmon, tuna, mackerel, cod and cod livers, lake herring, and from miscellaneous fish cuttings and waste. The production and value in 1929 was greater than for any year for which there are records.

SCRAP, MEAL, ETC.

In 1929 the production of marine animal scrap, meal, etc., amounted to 142,681 tons, valued at $6,801,362. This is an increase of 37 per cent in quantity and 26 per cent in value as compared with the production in 1928. Both quantity and value were greater than for any year during the period 1921 to 1928. Of the total production 23 per cent consisted of dried menhaden scrap and meal, 16 per cent acidulated menhaden scrap, 56 per cent miscellaneous dried scrap and meal (other than menhaden), 3 per cent crude or green scrap, and 2 per cent shrimp meal. The largest single item is pilchard meal in the miscellaneous dried scrap and meal group. The production of this commodity reached 36,500 tons, valued at $1,960,603, in 1929. All groups increased over 1928.

Production of miscellaneous by-products, 1929

Products	Atlantic and Gulf coasts		Pacific coast (including Alaska)		Total	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Dried scrap:						
Herring (Maine)...tons..	643	$22,221			643	$22,221
Alewife...do....	546	26,464			546	26,644
Ground fish...do....	156	7,500			156	7,500
Crab, king and blue...do....	1,468	39,861			1,468	39,861
Miscellaneous...do....	415	20,500			415	20,500
Meal:						
Salmon...do....			2,427	$140,961	2,427	140,961
Herring (Maine)...do....	2,184	123,227			2,184	123,227
Herring (Alaska)...do....			12,750	734,246	12,750	734,246
Pilchard...do....			36,500	1,960,603	36,500	1,960,603
Tuna...do....			6,186	302,710	6,186	302,710
Mackerel...do....			497	25,403	497	25,403
Whale meat and bone...do....			1,415	72,174	1,415	72,174
Ground fish...do....	13,142	883,549			13,142	883,549
Shrimp...do....	[1] 2,153	[1] 73,429	(1)	(1)	2,153	73,429
Miscellaneous...do....	208	10,200	1,321	68,377	1,529	78,577
Pomace, herring (Maine)...do....	826	28,642			826	28,642
Crude or green scrap, miscellaneous ...tons..	3,389	5,592	325	7,285	3,714	12,877
Oil:						
Salmon...gallons..			280,425	107,375	280,425	107,375
Herring (Maine)...do....	150,255	53,708			150,255	53,708
Herring (Alaska)...do....			3,341,179	1,407,041	3,341,179	1,407,041
Alewife...do....	19,232	8,371			19,232	8,371
Pilchard...do....			6,427,404	2,815,954	6,427,404	2,815,954
Tuna...do....			58,150	17,752	58,150	17,752
Mackerel...do....			31,377	10,621	31,377	10,621
Whale...do....			1,477,907	778,502	1,477,907	778,502
Sperm...do....			47,750	17,800	47,750	17,800
Cod-liver, crude...do....	264,809	184,284			264,809	184,284
Miscellaneous...do....	[2] 50,488	[2] 6,948	31,346	11,447	81,834	18,395
Liquid glue...do....	[3] 539,937	[3] 1,298,096	(3)	(3)	539,937	1,298,096
Miscellaneous by-products [4]..pounds..	2,448,466	40,654	2,706,118	156,911	5,154,584	197,565
Total...		2,833,426		8,635,162		11,468,588

[1] A small quantity of shrimp meal produced by one firm in California is included with the production of the Atlantic and Gulf coasts.
[2] Includes the production in Indiana.
[3] A small quantity of liquid glue produced by one firm in California is included with production of the Atlantic and Gulf coasts.
[4] Includes herring skins, scales, shark skins and fins, fish flour, agar, kelp products, isinglass, pickled whale meat, and whale bone.

NOTE.—The oils produced on the Pacific coast are reported in trade gallons (7½ pounds), and those produced on the Atlantic and Gulf coasts are reported in United States gallons (about 7.74 pounds).

Production of marine-animal oils, 1921 to 1929

Year	Menhaden		Herring		Pilchard or sardine	
	Gallons	*Value*	*Gallons*	*Value*	*Gallons*	*Value*
1921...	6,260,478	$1,719,892	112,838	$26,735	170,977	$35,760
1922...	7,102,677	2,904,833	450,362	150,144	428,859	145,668
1923...	7,461,365	3,316,277	945,424	384,053	966,247	424,103
1924...	3,923,904	1,817,626	1,324,002	571,399	2,338,711	1,076,903
1925...	6,023,108	3,001,106	2,442,527	1,034,071	3,120,048	1,568,753
1926...	3,942,821	1,729,160	3,116,936	1,382,763	2,113,028	932,651
1927...	3,957,068	1,716,474	2,291,687	960,250	2,514,562	1,116,725
1928...	3,585,569	1,455,376	2,743,065	1,085,799	3,825,786	1,621,531
1929...	3,172,735	1,381,816	3,510,666	1,469,120	6,427,404	2,815,954

Year	Whale and sperm		Other Marine animal oils		Total	
	Gallons	*Value*	*Gallons*	*Value*	*Gallons*	*Value*
1921...	[1] 168,729	$94,767	[1] 733,259	$201,516	7,446,281	$2,078,670
1922...	2,247,145	884,714	306,430	145,401	10,535,473	4,230,760
1923...	1,556,830	791,884	443,935	187,877	11,373,801	5,104,194
1924...	1,242,836	661,271	381,832	184,534	9,211,285	4,311,733
1925...	1,221,198	685,011	480,195	211,250	13,287,076	6,500,191
1926...	1,276,009	748,075	439,252	234,832	10,888,046	5,027,491
1927...	1,531,400	755,965	579,396	355,607	10,874,113	4,905,021
1928...	1,458,248	676,534	532,909	310,378	12,145,577	5,149,618
1929...	1,525,657	796,302	716,595	338,427	15,353,057	6,801,619

[1] Whale oil included with "Other fish oils" in 1921.

Production of marine-animal meal and scrap, 1921 to 1929

Year	Dried menhaden scrap and meal		Acidulated menhaden scrap		Shrimp meal	
	Tons	*Value*	*Tons*	*Value*	*Tons*	*Value*
1921	37,858	$1,380,455	44,804	$905,640	628	$16,814
1922	67,821	2,665,441	25,755	556,317	562	15,398
1923	43,452	2,029,406	44,935	1,064,870	1,269	48,290
1924	21,008	996,866	24,409	495,684	936	31,580
1925	30,167	1,519,458	41,463	1,102,051	1,079	31,658
1926	24,226	1,164,396	23,553	548,204	1,036	33,775
1927	26,417	1,406,915	19,984	566,590	1,427	44,716
1928	24,681	1,453,651	20,028	531,238	1,726	58,080
1929	33,041	1,625,694	23,089	622,544	2,153	73,429

Year	Crude or green scrap		Other dried scrap and meal		Total	
	Tons	*Value*	*Tons*	*Value*	*Tons*	*Value*
1921	1,810	$21,327	22,173	$1,232,906	107,273	$3,557,142
1922	390	9,175	21,638	1,090,346	116,[illegible]66	4,336,677
1923	1,593	13,721	22,636	1,257,098	113,885	4,413,385
1924	4,097	15,217	30,847	1,373,351	81,297	2,912,698
1925	5,787	16,430	39,566	1,981,038	118,062	4,650,635
1926	6,456	12,692	37,703	1,892,010	92,974	3,651,077
1927	1,960	8,942	42,078	2,293,919	91,866	4,321,082
1928	3,067	20,290	55,017	3,318,884	104,519	5,382,143
1929	4,540	41,519	79,858	4,438,176	142,681	6,801,362

GLUE

In 1929 liquid glue was manufactured at 1 plant in Maine, 5 in Massachusetts, and 1 in California. The production amounted to 539,937 gallons valued at $1,298,096. This is an increase of 6 per cent in quantity and 4 per cent in value compared with the production and value in the previous year. Both quantity and value are larger than those in any year during the period 1921 to 1928.

Production of fish glue, 1921 to 1929

Year	Gallons	Value	Year	Gallons	Value
1921	347,048	$364,415	1926	520,622	$732,109
1922	323,003	278,424	1927	512,136	860,396
1923	465,814	680,054	1928	510,587	1,254,082
1924	502,940	550,391	1929	539,937	1,298,096
1925	510,816	589,064			

OYSTER-SHELL PRODUCTS

In 1929 oyster-shell products were manufactured at 2 plants in Rhode Island, 1 in Connecticut, 5 in New Jersey, 4 in Pennsylvania, 7 in Maryland, 7 in Virginia, 2 in North Carolina, 4 in South Carolina, 2 in Florida, 2 in Alabama, 6 in Mississippi, 5 in Louisiana, 2 in Texas, and 1 in California—a total of 50 plants or 3 more than in 1928. These plants produced 262,232 tons of crushed oyster-shell for poultry feed valued at $2,223,853 and 72,534 tons of oyster-shell lime valued at $300,646—a total of 334,766 tons valued at $2,524,499. Compared with the total production of these products in 1928, there was an increase of 9 per cent in quantity and 3 per cent in value. The combined production in Louisiana, Texas, and California accounted for 44 per cent of the total quantity and 48 per cent of the total value. The shells taken in Louisiana, as well as those in California, are mainly from reefs containing deposits of many thousands of tons of dead oyster shells. Whole and crushed shells are often used for road-building purposes, although crushed shells are used mainly for poultry feed, and the shell dust resulting from the crushing operation is sold as lime. The value of the production in 1929 was somewhat greater than the average for the years 1921 to 1928, although the production has remained fairly constant throughout this period.

Production of oyster shell products, 1929

States	Crushed oyster shell for poultry feed		Oyster-shell lime		Total	
	Tons	*Value*	*Tons*	*Value*	*Tons*	*Value*
Rhode Island, Connecticut, and Pennsylvania	6,947	$71,780	1,990	$9,176	8,937	$80,956
New Jersey	8,073	77,283	2,258	9,576	10,331	86,859
Maryland	41,908	319,991	20,217	54,444	62,125	374,435
Virginia, North Carolina, and South Carolina	28,427	266,173	[1] 25,378	179,184	53,805	445,357
Florida and Alabama	16,427	112,349	4,180	9,445	20,607	121,794
Mississippi	27,670	202,132	4,518	4,418	32,188	206,550
Louisiana, Texas, and California	132,780	1,174,145	13,993	34,403	146,773	1,208,548
Total	262,232	2,223,853	72,534	300,646	334,766	2,524,499

[1] Of this amount, 13,545 tons valued at $115,474 were reported as "burned" lime.

Production of oyster-shell products, 1921 to 1929

Year	Crushed oyster-shell for poultry feed		Oyster-shell lime		Total
	Tons	*Value*	*Tons*	*Value*	*Value*
1921	185,474	$1,759,120	73,764	$502,634	$2,261,754
1922	236,021	2,005,838	93,168	431,213	2,437,051
1923	224,983	1,986,249	83,808	372,286	2,358,535
1924	219,211	2,019,254	70,269	336,384	2,355,638
1925	226,971	2,075,057	67,818	303,261	2,378,318
1926	251,166	2,379,141	57,232	207,019	2,586,160
1927	249,959	2,332,065	60,560	268,985	2,601,050
1928	237,305	2,155,985	68,708	303,439	2,459,424
1929	262,232	2,223,853	72,534	300,646	2,524,499

FRESH-WATER MUSSEL-SHELL PRODUCTS

In 1929 statistics of the fresh-water mussel shell industry were obtained for the first time in connection with the canned fishery products and by-products survey. The value of the products of this industry amounted to $6,144,515. Of this value pearl buttons alone accounted for 94 per cent. The remaining 6 per cent consisted of crushed shell for poultry feed, lime, cut shells, stucco, and colored shell and colored shell chips used for decorative purposes. The total production of finished pearl buttons amounted to 20,205,073 gross valued at $5,795,863. The production in Iowa alone accounted for 67 per cent of the quantity and 71 per cent of the value of the buttons. Iowa also accounted for the greater portion of the production of other products.

Mussel shells utilized in the above production amounted to 54,352,000 pounds, valued at $1,324,919. Shells were taken in 19 States in the Mississippi Valley and Great Lakes region. The larger producing

States were Tennessee with 21 per cent of the total shells; Arkansas, 20 per cent; Michigan, 10 per cent; Iowa, 8 per cent; Indiana, 8 per cent; Illinois, 8 per cent; and Wisconsin, 7 per cent.

Production of fresh-water mussel-shell products, 1929

Items	Iowa		Other States		Total	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Pearl buttons..........gross..	13, 559, 994	$4, 129, 158	6, 645, 079	$1, 666, 705	20, 205, 073	$5, 795, 863
Crushed shell for poultry feed ....tons..	11, 329	127, 227	443	3, 330	11, 772	130, 557
Lime..................do....	1, 362	1, 951	195	550	1, 557	2, 501
Other products [1].......do....	[2] 5, 014	[2] 215, 594	(2)	(2)	5, 014	215, 594
Total..................	....	4, 473, 930	....	1, 670, 585	....	6, 144, 515

[1] Include cut shells, stucco and colored shells and colored shell chips used for decorative purposes.
[2] A small production made in other States has been included with Iowa.

MENHADEN INDUSTRY

In 1929, 1 menhaden factory was operated in Connecticut, 1 in New York, 2 in New Jersey, 2 in Delaware, 12 in Virginia, 12 in North Carolina, 1 in South Carolina, 1 in Georgia, and 5 in Florida—a total of 37 factories, or 3 more than in 1928. These plants utilized 660,363,000 fish in the manufacture of 33,041 tons of dried scrap and meal, valued at $1,625,694; 23,089 tons of acidulated scrap, valued at $622,544, and 3,172,735 gallons of oil, valued at $1,381,816, making a total value for these products of $3,630,054. This is an increase of 6 per cent in value over that for the previous year, but is considerably under the production for several of the years during the past decade. As a result of increased activities in the menhaden industry in Florida, the value of the products in South Carolina, Georgia, and Florida accounted for 32 per cent of the total value of all menhaden products. Virginia accounted for 30 per cent, North Carolina, 23 per cent; and Connecticut, New York, New Jersey, and Delaware, 15 per cent.

Fish utilized and products of the menhaden industry, 1929

States	Menhaden utilized	Products						
		Dry scrap and meal		Acidulated scrap		Oil		Total
	Number	*Tons*	*Value*	*Tons*	*Value*	*Gallons*	*Value*	*Value*
Connecticut, New York, New Jersey, and Delaware......	69, 164, 000	1, 517	$74, 574	4, 605	$146, 833	705, 105	$311, 597	$533, 004
Virginia..............	173, 294, 000	12, 628	602, 291	....	....	1, 107, 077	486, 996	1, 089, 287
North Carolina	146, 840, 000	7, 103	347, 894	5, 887	158, 184	753, 722	323, 904	829, 982
South Carolina, Georgia, and Florida............	271, 065, 000	11, 793	600, 935	12, 597	317, 527	606, 831	259, 319	1, 177, 781
Total..........	[1] 660,363, 000	[2] 33,041	1, 625, 694	23, 089	622, 544	3, 172, 735	1, 381, 816	3, 630, 054

[1] 396,217,800 pounds.
[2] Of this quantity, 24,189 tons, valued at $1,150,509 were reported as dry scrap, and 8,852 tons, valued at $475,185, as fish meal.

Products of the menhaden industry, 1921 to 1929

Year	Dried scrap and meal		Acidulated scrap		Oil		Total
	Tons	*Value*	*Tons*	*Value*	*Gallons*	*Value*	*Value*
1921	37,858	$1,380,455	44,804	$905,640	6,260,478	$1,719,892	$4,005,987
1922	67,821	2,665,441	25,755	556,317	7,102,677	2,904,833	6,126,591
1923	43,452	2,029,406	44,935	1,064,870	7,461,365	3,316,277	6,410,553
1924	21,008	996,866	24,409	495,684	3,923,904	1,817,626	3,310,176
1925	30,167	1,519,458	41,463	1,102,051	6,023,108	3,001,106	5,622,615
1926	24,226	1,164,396	23,553	548,204	3,942,821	1,729,160	3,441,760
1927	26,417	1,406,915	19,984	566,590	3,957,068	1,716,474	3,689,979
1928	24,681	1,453,651	20,028	531,238	3,585,569	1,455,376	3,440,265
1929	33,041	1,625,694	23,089	622,544	3,172,735	1,381,816	3,630,054

TIGHT-PACK CUT HERRING TRADE

During 1929 there were 13,843 barrels of tight-pack cut herring, valued at $84,204, packed in Maryland and Virginia. Of this amount, 13,013 barrels, valued at $79,079, were prepared in Virginia, and 830 barrels, valued at $5,125, in Maryland.

There were 26 firms engaged in the industry, 23 of which were in Virginia and 3 in Maryland. Of those in Virginia, 21 were in Lancaster and Northumberland Counties.

PACKAGED-FISH TRADE

Fresh, frozen, and smoked packaged fish were prepared in 1929 in 6 plants in Maine, 55 in Massachusetts, 1 in Connecticut, 28 in New York, 9 in Virginia, 1 in North Carolina, 3 in Florida, 1 in Alabama, 1 in Pennsylvania, 3 in Washington, 2 in Oregon, and 2 in California—a total of 112 plants, or an increase of 27 over those operated in 1928. The production of packaged fish in 1929 amounted to 84,396,505 pounds, valued at $14,812,987, as compared with 65,245,376 pounds, valued at $9,790,024 for 1928. This represents an increase of 29 per cent in amount and 51 per cent in value. It has been estimated that to produce the packaged-fish products prepared in 1929, 212,000,000 pounds of whole fish were utilized.

According to quantity, by far the most important fish packaged was haddock, which accounted for 85 per cent of the total quantity prepared. Following in order were cod with 4 per cent of the total, hake with 3 per cent, squeteague with 2 per cent, and cusk with 1 per cent. About 20 other species were packaged in smaller quantities. Prominent among these species of less importance were flounders and croakers.

The combined production of Massachusetts and Connecticut accounted for 85 per cent of the total output; New York, 9 per cent; Virginia and North Carolina combined, 3 per cent; and Maine, 2 per cent. The total production in all other States amounted to less than 1 per cent of the total.

Considered according to the method of preparation, fillets accounted for 93 per cent; dressed or pan-dressed fish, 4 per cent; and sticks, 3 per cent. The production of steaks and tenderloins amounted to less than one-half of 1 per cent. Of the total quantity, 72 per cent were marketed fresh, 26 per cent frozen, and 2 per cent smoked.

Production of fresh, frozen, and smoked packaged fish in the United States, 1929

Species	Maine		Massachusetts and Connecticut		New York	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod	335,500	$60,340	2,309,251	$392,368	[1] 840,000	[1] $148,300
Cusk	211,100	37,527	1,013,327	147,037		
Flounders, including "sole," "dabs," and "California halibut"	14,000	2,740	366,731	104,584	159,500	42,515
Haddock	891,572	141,427	63,912,492	11,427,218	6,171,000	1,103,400
Hake	275,250	46,792	2,164,074	294,538	177,000	25,530
Halibut			(2)	(2)		
Mackerel			16,416	3,929		
Pollock			412,245	46,429		
Wolffish			45,081	10,911		
Miscellaneous [3]			1,573,714	236,307		
Total	1,727,422	288,826	71,813,331	12,663,321	7,347,500	1,319,745

Species	Virginia and North Carolina		Florida, Alabama, and Pennsylvania		Washington, Oregon, and California		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Butterfish	46,660	$7,080					46,660	$7,080
Cod	(1)	(1)					3,484,751	601,008
Croaker	649,844	69,710					649,844	69,710
Cusk							1,224,427	184,564
Flounders, including "sole," "dabs," and "California halibut"	67,950	7,471			315,150	$64,208	923,331	221,518
Groupers			33,000	$6,450			33,000	6,450
Haddock	391,715	59,548					71,366,779	12,731,593
Hake							2,616,324	366,860
Halibut					[2] 183,282	[2] 37,191	183,282	37,191
Mackerel							16,416	3,929
Pollock							412,245	46,429
Salmon					30,759	6,637	30,759	6,637
Snapper, red			45,500	10,625			45,500	10,625
Spot	10,700	1,665					10,700	1,665
Squeteagues	1,324,332	165,896					1,324,332	165,896
Wolffish							45,081	10,911
Miscellaneous [3]	22,300	2,350	178,050	57,881	209,010	44,383	1,983,074	340,921
Total	2,513,501	313,720	256,550	74,956	738,201	152,419	[4] 84,396,505	14,812,987

[1] A small amount of cod packaged in Virginia has been included with New York.

[2] A small amount of halibut packaged in Massachusetts has been included with Washington, Oregon, and California.

[3] Includes barracuda, blue pike, "lingcod," rockfish, sablefish, seabass, snook, whiting, yellow perch, and other species.

[4] Of this amount, 78,413,938 pounds, valued at $13,950,601, were fillets; 3,291,094 pounds, valued at $419,430 were dressed or pan-dressed; 230,259 pounds, valued at $46,279, were steaks; 2,400,214 pounds, valued at $382,987, were sticks; and 61,000 pounds, valued at $13,700, were tenderloins. Of the total quantity of fillets prepared, 55,095,723 pounds, valued at $9,800,803, were fresh; 21,632,860 pounds, valued at $3,877,319 were frozen; and 1,685,355 pounds, valued at $272,479, were smoked. Of the steaks, all were marketed frozen, with the exception of 15,000 pounds, valued at $3,000, which were fresh. Only a small amount of dressed and pan-dressed fish were frozen, all the remaining fish in this group as well as those in the stick and tenderloin groups being marketed fresh.

FROZEN-FISH TRADE

FISH FROZEN

In 1929 the freezing plants in the United States and Alaska, reporting their activities to the Government, packed 121,542,589 pounds of frozen fishery products. These products, at the time they were held in cold-storage plants, were estimated to be valued at $15,000,000. This is the largest frozen pack of fishery products on record and exceeded the volume of the pack in 1928 by 7 per cent. Over one-half of the pack consisted of six species of fish. Listed in order of importance they were: Halibut, with 12 per cent of the total; salmon, 10 per cent; mackerel, 9 per cent; cod, haddock, haddock fillets, hake, and pollock, 9 per cent; whiting, 7 per cent; and sea herring, 7 per cent. Considerable quantities of shellfish, squid, croaker, butterfish, and lake herring also were frozen. Frozen squid and sea herring are marketed primarily for bait, although quantities of each are used for human consumption.

The above does not represent the entire amount of ground fish frozen during 1929, for it must be borne in mind that the above figures are obtained mainly from public freezing plants that report their operations to the Government. During late years an increasing number of privately owned establishments have been preparing frozen package fishery products, and many of these did not begin reporting their activities to the Government until late in the fall of 1929. However, an idea of the production of frozen package fish

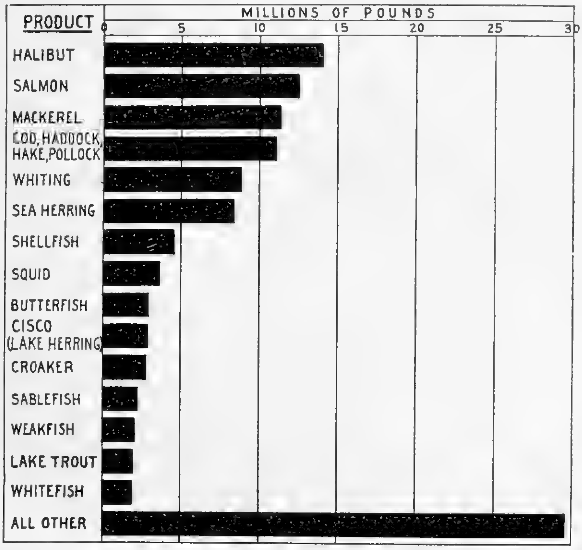

FIGURE 8.—Production of frozen fishery products in the United States and Alaska, 1929. Salmon includes steelhead trout; sea herring includes alewives and bluebacks; cisco includes bluefin, blackfin, and chub

may be gained from the review of the package fish trade in 1929, which appears on pages — and — of this report. In brief, according to this, the frozen pack of packaged fishery products in 1929 amounted to 21,849,120 pounds, valued at $3,920,688. This is an increase of 71 per cent when compared with the volume of these products packed in 1928.

Among the important species, by volume, frozen in 1929, that of frozen ground fish increased 130 per cent over the production of this group in 1928. That of sea herring increased 37 per cent, and halibut 12 per cent. The pack of other important species fared less well, for, that of mackerel decreased 2 per cent; chinook salmon, 12 per cent; silver salmon, 20 per cent; and whiting, 16 per cent. Some of the minor species show increases of 50 to over 100 per cent. On the whole there were greater quantities of the various salt-water species frozen in 1929 than in the preceding year, and lesser quantities of the fresh-water species.

That part of the catch of a species of fish which is to be frozen is determined by the kind of fish, its adaptability for preserving in certain manners, the locality of capture, and custom. Also, freezing sometimes is an intermediate step in preservation, especially with sturgeon and whitefish, as quantities of these are frozen and later smoked. While no complete figures are available over a period of years of the amount of certain species of fish frozen annually compared with their catch, it is certain that each year the ratio of amount frozen to catch is increasing with many species, such as whiting, halibut, salmon, cod, and haddock.

As with the preservation of other food products, the actual season for freezing fishery products coincides with the season when the product is in abundance, and this season varies with the fish preserved. Halibut are in season from February 15 to November 15; mackerel, April to December; whiting, May to December; salmon, April to December; croaker, February to November; butterfish, May to November; ground fish and herring, all year; and so on. As a general rule, most of the species frozen are in abundance during the six warm months of the year.

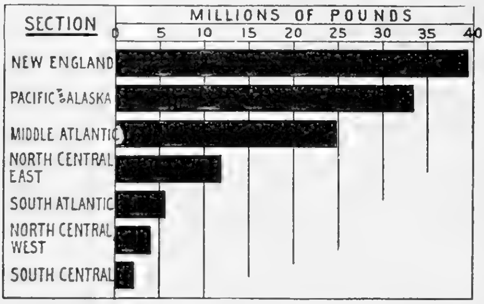

FIGURE 9.—Production of frozen fishery products in the various geographical sections, 1929

During 1929 nearly three-fourths of the frozen pack was put up during the months of June to November, inclusive. The amount frozen during August was largest, and accounted for 15 per cent of the total. The amounts frozen during the months of June, July, and November were about equal, each accounting for about 12 per cent of the total. A comparatively small amount was frozen during the months from January to May, inclusive. The least quantity was frozen in March. From May on the volume of the trade increased and continued at a high level until November. During the latter period about 15,000,000 pounds were packed monthly on the average which was about three times the average monthly freezings for the early period of the year—January to May. The action of the trade in 1929 was practically a duplicate of a normal year as to the season when the trade was at its highest and lowest levels.

The New England section led in the volume of fish frozen during 1929, for 39,511,000 pounds were put up there, which was about one-third of the total pack. Ground fish, mackerel, whiting, herring, and squid accounted for 81 per cent of the entire pack in this section. In the Pacific section, including Alaska, 33,318,000 pounds were frozen, which is somewhat more than one-fourth of the total pack. Salmon and halibut were the leading species preserved in this section, these accounting for 70 per cent of the production in this section. In the Middle Atlantic section 24,944,000 pounds were frozen, or about one-fifth of the total. A large variety of diversified species were frozen here, although those most predominant were mackerel, butterfish, whiting, weakfish, and shellfish. The freezers in this section preserved large quantities of fish produced by traps along the New Jersey coast. In the North Central East section 10 per cent of the total was frozen. Here the predominant species were lake herring, lake trout, and whitefish. The other sections during 1929 were relatively unimportant in the trade and froze small quantities of fish common to each section.

The freezing plants in the New England section were busiest from June to November, inclusive. Those in the Pacific section during August, September, and October; those in the Middle Atlantic section during June and November with the amount frozen during the other months of the year being somewhat uniform and at a fairly high level. Those plants in the North Central East section were busiest during June, November, and December; and those in the other sections were busiest mostly during the summer or late fall.

Production of frozen fishery products, 1929

BY SPECIES AND MONTHS

Species	Month ended the 15th of—						
	January	February	March	April	May	June	July
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Bluefish (all trade sizes)	13,956	10,242	2,275	4,452	3,917	104,538	245,816
Butterfish (all trade sizes)	660	3,817	2,321	----------	180,756	1,263,168	781,716
Catfish	96,042	31,752	8,277	10,765	13,220	49,330	91,597
Cisco (Lake Erie)	6,841	108	1,487	----------	3,199	26,327	45,358
Cisco (lake herring), including bluefin, blackfin, and chub	90,089	45,128	46,279	21,479	46,664	115,333	53,584
Cisco (tullibees, Canadian lakes)	114,564	127,596	117,628	27,958	5,577	79,286	41,831
Cod, haddock, hake, pollock	332,378	85,322	220,026	623,813	712,390	931,547	910,501
Croaker	8,770	34,325	12,755	837,524	39,176	318,383	265,880
Flounders	43,145	37,444	15,670	133,457	208,001	412,389	166,922
Halibut (all trade sizes)	204,641	193,346	538,128	596,533	1,989,158	1,974,447	1,718,635
Herring, sea (including alewives and bluebacks)	168,054	773,519	761,518	446,707	501,872	581,597	326,164
Lake trout	40,160	31,879	12,885	58,628	29,945	103,958	57,716
Mackerel (except Spanish)	232,401	164,053	155,387	56,157	252,409	1,567,377	3,496,470
Pike, blue and sauger	10,648	450	10,184	1,404	15,621	62,589	44,055
Pike, yellow or wall-eyed	16,695	5,242	6,623	53	13,185	35,635	46,867
Pike (including pickerel, jacks, and yellow jack)	44,199	128,115	31,772	93,681	21,310	23,958	14,863
Sablefish (black cod)	27,183	32,798	16,860	12,695	47,284	77,154	170,691
Salmon, chinook	3,560	2,580	----------	----------	50,430	157,923	414,532
Salmon, silver	198,228	153,929	94,312	2,607	28,070	108,819	380,964
Salmon, fall and pink	75,014	108,579	37,475	5,978	20,443	3,694	13,306
Salmon, steelhead trout	191,448	8,749	11,483	----------	6,407	20,960	228,892
Salmon, all other	64,216	70,525	69,348	12,164	100,776	298,694	487,864
Scup (porgies)	11,441	303	3,158	----------	132,979	399,567	184,907
Shad and shad roe	22,542	59,033	18,031	11,430	92,451	168,596	22,103
Shellfish	296,174	531,049	166,736	113,627	147,012	326,629	398,832
Smelts, eulachon, etc	382,938	515,291	126,471	53,713	6,786	35,449	110
Squid	24,907	16,210	9,262	64,008	895,990	1,713,732	280,989
Sturgeon and spoonbill cat	12,682	4,308	747	7,260	41,556	81,266	175,930
Suckers	4,119	11,300	8,606	9,966	544	63,487	2,810
Weakfish (including southern "sea trout")	137,010	108,599	81,216	69,599	141,689	251,081	245,608
Whitefish	48,880	77,337	70,934	117,268	90,580	247,501	225,083
Whiting	395,382	29,849	138,574	14,205	124,197	989,845	2,343,868
Miscellaneous frozen fish	1,192,496	724,873	572,194	1,834,338	1,039,921	1,788,818	1,948,964
Total	4,511,463	4,127,650	3,368,622	5,241,469	7,003,515	14,383,077	15,833,428

Production of frozen fishery products, 1929—Continued

BY SPECIES AND MONTHS—Continued

Species	Month ended the 15th of—					
	August	September	October	November	December	Total
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Bluefish (all trade sizes)	322, 510	101, 487	51, 486	15, 644	7, 631	883, 954
Butterfish (all trade sizes)	208, 005	228, 867	58, 368	177, 118	27, 810	2, 932, 606
Catfish	200, 933	90, 737	37, 545	92, 165	142, 634	864, 997
Cisco (Lake Erie)	35, 040	122, 448	20, 449	27, 762	50, 833	339, 852
Cisco (lake herring), including bluefin, blackfin, and chub	219, 299	268, 544	177, 663	896, 099	949, 988	2, 930, 149
Cicso (tullibees, Canadian lakes)	45, 391	9, 766	25, 432	117, 564	27, 070	739, 663
Cod, haddock, hake, pollock	1, 607, 654	1, 151, 800	1, 299, 499	2, 091, 704	1, 213, 325	11, 179, 959
Croaker	927, 900	382, 583	19, 892	20, 567	10, 241	2, 877, 996
Flounders	102, 883	50, 478	111, 058	173, 076	86, 470	1, 540, 993
Halibut (all trade sizes)	1, 672, 398	2, 007, 878	1, 577, 118	499, 287	1, 111, 661	14, 083, 230
Herring, sea (including alewives and bluebacks)	815, 194	922, 951	619, 538	1, 773, 554	717, 871	8, 408, 539
Lake trout	138, 159	116, 266	204, 338	1, 004, 943	237, 272	2, 036, 149
Mackerel (except Spanish)	1, 519, 823	1, 233, 425	2, 045, 169	297, 631	281, 172	11, 301, 474
Pike, blue and sauger	15, 105	17, 168	194, 798	305, 919	214, 316	892, 257
Pike, yellow or wall-eyed	21, 903	60, 695	28, 793	19, 484	1, 355	256, 530
Pike (including pickerel, jacks, and yellow jack)	29, 416	54, 245	83, 674	92, 950	8, 541	626, 724
Sablefish (black cod)	197, 103	354, 222	444, 761	762, 756	193, 326	2, 336, 833
Salmon, chinook	328, 405	289, 558	179, 607	10, 091	52, 856	1, 489, 542
Salmon, silver	1, 354, 529	740, 471	960, 931	746, 061	90, 915	4, 859, 836
Salmon, fall and pink	354, 874	79, 229	553, 742	1, 121, 291	169, 023	2, 542, 648
Salmon, steelhead trout	389, 363	221, 828	60, 076	12, 817	23, 149	1, 175, 172
Salmon, all other	423, 604	369, 428	319, 360	111, 642	46, 520	2, 374, 141
Scup (porgies)	281, 083	47, 818	840	3, 686		1, 065, 782
Shad and shad roe	96, 948	61, 304	2, 009	8, 008	40, 895	603, 350
Shellfish	244, 416	464, 927	473, 653	971, 739	485, 714	4, 620, 508
Smelts, eulachon, etc	1, 160	13, 623	17, 548	39, 506	123, 568	1, 316, 163
Squid	353, 377	255, 191	6, 298	129, 198	36, 509	3, 785, 671
Sturgeon and spoonbill cat	46, 653	133, 058	20, 530	634, 250	17, 981	1, 176, 221
Suckers	1, 216	15, 965	16, 857	12, 099	850	147, 819
Weakfish (including southern "sea trout")	386, 403	438, 812	164, 494	90, 831	30, 404	2, 145, 746
Whitefish	214, 010	164, 334	77, 424	429, 189	199, 085	1, 961, 625
Whiting	2, 372, 997	298, 065	292, 948	840, 610	993, 541	8, 834, 081
Miscellaneous frozen fish	2, 631, 700	2, 003, 377	1, 683, 629	1, 814, 028	1, 978, 041	19, 212, 379
Total	17, 559, 454	12, 770, 548	11, 829, 527	15, 343, 269	9, 570, 567	121, 542, 589

Production of frozen fishery products, 1929—Continued

BY GEOGRAPHICAL SECTIONS AND SPECIES [1]

[Expressed in thousands of pounds; that is, 000 omitted]

Species	New England	Middle Atlantic	South Atlantic	North Central, East	North Central, West	South Central	Pacific	Total
Bluefish (all trade sizes)	10	775	19	71	7	2		884
Butterfish (all trade sizes)	424	2, 261	218	30				2, 933
Catfish	50	9	120	202	295	189		865
Cisco (Lake Erie)		330		9			1	340
Cisco (lake herring), including bluefin, blackfin, and chub		495		1, 690	745			2, 930
Cisco (tullibees, Canadian lakes)	41	401		205	91		2	740
Cod, haddock, hake, pollock	9, 491	632	17	111	669	17	243	11, 180
Croakers		1, 096	1, 568	214				2, 878
Flounders	755	749		5	1		31	1, 541
Halibut (all trade sizes)	299	654		780	79	1	12, 270	14, 083
Herring, sea (including alewives and bluebacks)	5, 230	473	1	621	57		2, 027	8, 409
Lake trout	2	177		1, 686	169	2		2, 036
Mackerel (except Spanish)	8, 197	2, 468		118	95		423	11, 301
Pike, blue and sauger	10	487		363	1	16	15	892
Pike, yellow or wall-eyed		80		172	4			256
Pike (including pickerel, jack and yellow jack)		33		413	181			627
Sablefish (black cod)				36	25		2, 276	2, 337
Salmon, chinook	2	22		43	8		1, 415	1, 490
Salmon, silver	51	226		55	9		4, 519	4, 860
Salmon, pink	12	59	17	95	16		2, 344	2, 543
Salmon, steelhead trout		7					1, 168	1, 175
Salmon, all other	50	171		110	26		2, 017	2, 374
Scup (porgies)	237	818		2	9			1, 066
Shad and shad roe	110	232	4	65	4		188	603
Shellfish	394	1, 503	524	868	206	5	1, 120	4, 620
Smelts, eulachon, etc	31	1, 099		83	2		101	1, 316
Squid	2, 667	1, 086		32	1			3, 786
Sturgeon and spoonbill cat		954	9	32	45	38	98	1, 176
Suckers		3		141	2	2		148
Weakfish (including southern "sea trout")		1, 571	575					2, 146
Whitefish	15	572		1, 149	223	3		1, 962
Whiting	6, 379	2, 234	9	9	202	1		8, 834
Miscellaneous frozen fish	5, 054	3, 267	2, 584	2, 494	886	1, 867	3, 060	19, 212
Total	39, 511	24, 944	5, 665	11, 904	4, 058	2, 143	33, 318	121, 543

BY GEOGRAPHICAL SECTIONS AND MONTHS [1]

[Expressed in thousands of pounds; that is, 000 omitted]

Month ended the 15th of—	New England	Middle Atlantic	South Atlantic	North Central, East	North Central, West	South Central	Pacific	Total
January	383	1, 376	119	780	779	108	966	4, 511
February	76	1, 398	58	912	154	78	1, 452	4, 128
March	224	728	23	407	102	102	1, 783	3, 369
April	821	1, 272	840	510	159	388	1, 251	5, 241
May	2, 122	1, 388	231	264	160	116	2, 723	7, 004
June	4, 973	4, 042	507	1, 803	84	225	2, 749	14, 383
July	8, 375	2, 427	647	718	211	208	3, 247	15, 833
August	7, 920	2, 670	1, 044	594	442	299	4, 590	17, 559
September	4, 418	2, 084	575	958	356	194	4, 186	12, 771
October	3, 888	1, 788	167	831	333	119	4, 704	11, 830
November	4, 317	3, 269	520	2, 620	730	145	3, 742	15, 343
December	1, 994	2, 502	934	1, 507	548	161	1, 925	9, 571
Total	39, 511	24, 944	5, 665	11, 904	4, 058	2, 143	33, 318	121, 543

[1] New England includes the six States of that section; Middle Atlantic—New York, New Jersey, and Pennsylvania; South Atlantic—Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, and Florida; North Central, East—Ohio, Indiana, Illinois, Michigan, and Wisconsin; North Central, West—Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas; South Central—Kentucky, Tennessee, Alabama, Mississippi, Louisiana, Texas, Oklahoma, and Arkansas; Pacific—Washington, Oregon, California, and Alaska.

Production of frozen fishery products in various years, 1920 to 1929

[Expressed in thousands of pounds; that is, 000 omitted]

Year	Month ended the 15th of—						
	January	February	March	April	May	June	July
1920	2,291	2,274	2,630	2,465	3,688	10,094	12,762
1921	4,005	2,843	1,770	2,413	2,698	9,624	10,151
1922	2,442	1,453	1,364	1,497	1,980	5,850	7,376
1923	2,742	1,662	1,412	1,400	5,027	7,671	11,872
1924	3,179	2,440	2,417	2,729	6,040	8,282	11,996
1925	3,933	2,193	3,488	4,315	5,857	10,800	11,221
1928	2,349	2,849	4,542	2,202	5,518	18,415	16,046
1929	4,511	4,128	3,369	5,241	7,004	14,383	15,833

Year	Month ended the 15th of—					Total
	August	September	October	November	December	
1920	13,620	11,804	11,169	9,712	9,751	92,260
1921	9,845	9,356	9,990	9,869	8,173	80,737
1922	9,121	10,827	16,830	9,344	7,070	75,154
1923	13,944	16,417	12,512	6,952	9,938	91,549
1924	15,542	10,585	14,878	10,855	8,381	97,324
1925	10,902	11,595	8,593	11,718	6,550	91,165
1928	17,130	11,263	9,373	13,403	10,548	113,638
1929	17,559	12,771	11,830	15,343	9,571	121,543

Production of frozen fishery products in 1929 and 1928, compared

Species	1929	1928	Increase (+) or decrease (−) 1929 compared with 1928
	Pounds	*Pounds*	*Per cent*
Bluefish (all trade sizes)	883,954	687,966	+28
Butterfish (all trade sizes)	2,932,606	1,477,405	+98
Catfish	864,997	457,666	+89
Cisco (Lake Erie)	339,852	645,455	−47
Cisco (lake herring), including bluefin, blackfin, and chub	2,930,149	2,061,152	+42
Cisco (tullibees, Canadian lakes)	739,663	1,303,409	−43
Cod, haddock, hake, pollock	11,179,959	4,854,217	+130
Croaker	2,877,996	1,754,454	+64
Flounders	1,540,993	1,465,223	+5
Halibut (all trade sizes)	14,083,230	12,525,445	+12
Herring, sea (including alewives and bluebacks)	8,408,539	6,152,244	+37
Lake trout	2,036,149	2,537,181	−20
Mackerel (except Spanish)	11,301,474	11,550,854	−2
Pike, blue and sauger	892,257	1,789,656	−50
Pike, yellow or wall-eyed	256,530	349,112	−27
Pike (including pickerel, jacks, and yellow jack)	626,724	874,880	−28
Sablefish (black cod)	2,336,833	2,106,414	+11
Salmon, chinook	1,489,542	1,689,039	−12
Salmon, silver	4,859,836	6,067,298	−20
Salmon, fall and pink	2,542,648	2,538,690	(+)
Salmon, steelhead trout	1,175,172	1,137,747	+3
Salmon, all other	2,374,141	3,212,011	−26
Scup (porgies)	1,065,782	1,218,785	−13
Shad and shad roe	603,350	604,451	(−)
Shellfish	4,620,508	6,096,031	−24
Smelts, eulachon, etc	1,316,163	748,751	+76
Squid	3,785,671	6,801,199	−44
Sturgeon and spoonbill cat	1,176,221	527,100	+123
Suckers	147,819	164,817	−10
Weakfish (including southern "sea trout")	2,145,746	3,221,982	−34
Whitefish	1,961,625	1,616,203	+21
Whiting	8,834,081	10,514,686	−16
Miscellaneous frozen fish	19,212,379	14,886,375	+29
Total	121,542,589	113,637,898	+7

Production of certain species of frozen fish for various years 1920 to 1929

Year	Mackerel	Salmon [1]	Halibut	Whiting	Cod, haddock, hake, and pollock
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1920	4,835,173	7,836,620	10,625,029	10,208,755	3,940,163
1921	2,694,684	10,033,619	10,733,803	5,527,047	1,922,154
1922	6,165,248	12,143,194	5,122,396	6,058,126	1,045,462
1923	7,248,381	11,043,424	10,211,251	8,664,680	2,222,677
1924	5,457,676	14,309,666	14,650,787	7,528,339	1,862,163
1925	8,948,297	12,153,515	12,041,155	10,152,799	2,781,419
1928	11,550,854	14,644,785	12,525,445	10,514,686	4,854,217
1929	11,301,474	12,441,339	14,083,230	8,834,081	11,179,959

[1] Including steelhead trout.

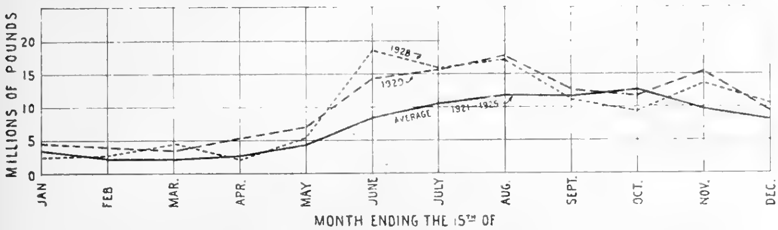

FIGURE 10.—Fish frozen monthly in 1928 and 1929 and the 5-year average, 1921 to 1925

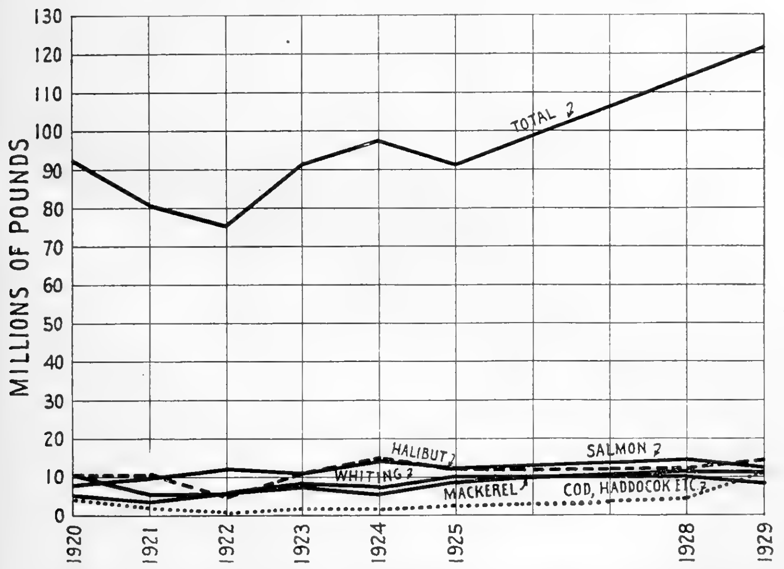

FIGURE 11.—Fishery products frozen in the United States and Alaska for various years, 1920 to 1929

HOLDINGS

During 1929 the average monthly holdings of frozen fish and shellfish increased 4 per cent over the average monthly holdings during 1928 and 17 per cent over the 5-year average of monthly holdings. Individual monthly holdings during the year had a tendency to be above normal, for, during each month they were from 12 to 42 per cent higher than the 5-year average. Compared with the respective monthly holdings in 1928 they were 2 to 20 per cent higher during eight months of the year and 2 or 3 per cent lower during only four months. Monthly holdings in 1929 were largest from August to December, inclusive, being in many instances more than double those for certain months from January to July, inclusive. This is correlated[3] somewhat with the amounts of fish frozen in that there is an accumulation of stocks during the summer when most fishing is done. These are then carried over until winter when there is little fishing. At this time they are drawn upon heavily and reach a low ebb just at the beginning of the spring fishing season.

A maximum of 79,439,000 pounds were held on November 15 and a minimum of 30,174,000 pounds on May 15. Holdings during the year averaged about 55,900,000 pounds monthly.

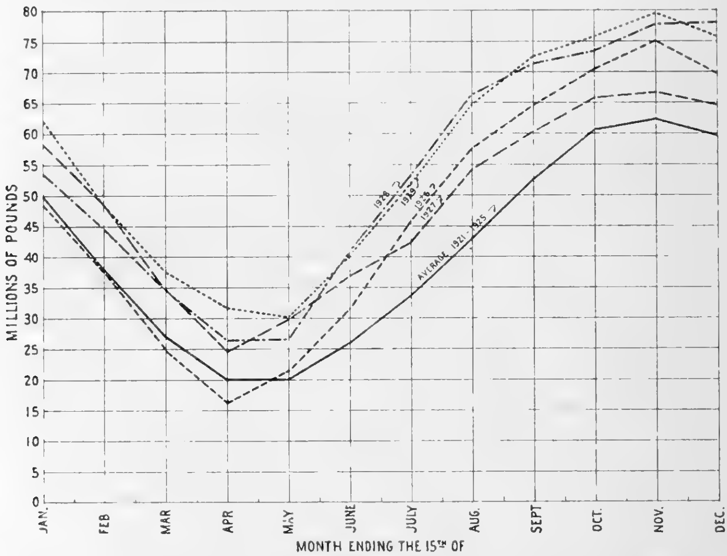

FIGURE 12.—Monthly holdings of frozen fish, 1926 to 1929 and 5-year average, 1921 to 1925

On the average, the monthly holdings in the New England section were greatest. In 1929 they amounted to 15,241,000 pounds. Large quantities of frozen package fish are held in this section. Monthly holdings in the Middle Atlantic section were second largest, and amounted to 14,759,000 pounds on the average, in spite of the fact this section ranked third in the amount of fish and shellfish frozen in 1929. The large holdings in this section are due to the imports from other sections (such as the Pacific Coast, North Central East, and North Central West, sections), which are stored here pending sale in the large consumption centers in the Middle Atlantic section. Monthly holdings in the Pacific section were third largest, and averaged 12,090,000 pounds. The monthly holdings in the other sections averaged between 770,000 and 7,552,000 pounds.

[3] Holdings can not be correlated directly with the amount of fish frozen, due to the fact that we import fish frozen in Canada and Mexico and certain other countries, although general deductions can be drawn.

Holdings of frozen fishery products, by species and months, 1929

Species	Month ended the 15th of—					
	January	February	March	April	May	June
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
(all trade sizes)	581, 317	469, 577	359, 290	264, 792	203, 266	259, 947
Butterfish (all trade sizes)	708, 540	480, 279	295, 948	219, 435	353, 125	1, 591, 095
Catfish	287, 344	228, 472	116, 296	68, 890	59, 002	93, 924
Cisco (Lake Erie)	146, 444	103, 879	62, 961	52, 491	45, 357	40, 817
Cisco (lake herring), including bluefin, blackfin, and chub	1, 587, 209	773, 147	497, 069	328, 608	168, 409	223, 099
Cisco (tullibees, Canadian lakes)	1, 849, 916	2, 269, 891	2, 387, 259	1, 942, 276	1, 601, 880	1, 483, 132
Cod, haddock, hake, pollock	2, 957, 609	1, 482, 275	1, 068, 767	1, 486, 011	2, 021, 324	2, 969, 942
Croaker	495, 040	323, 622	87, 371	860, 775	415, 101	653, 170
Flounders	826, 308	613, 677	487, 169	498, 835	651, 878	856, 448
Halibut (all trade sizes)	4, 747, 250	2, 868, 110	2, 171, 749	2, 351, 050	4, 123, 865	5, 932, 80[illegible]
Herring, sea (including alewives and bluebacks)	2, 196, 315	1, 846, 071	1, 963, 822	1, 694, 690	1, 675, 950	1, 714, 353
Lake trout	1, 878, 725	1, 342, 644	799, 555	562, 859	449, 751	462, 81[illegible]
Mackerel (except Spanish)	7, 456, 437	5, 884, 517	3, 993, 333	2, 435, 463	1, 574, 300	2, 886, 12[illegible]
Pike, blue and sauger	1, 129, 787	903, 019	638, 092	521, 219	448, 489	434, 57[illegible]
Pike, yellow or wall-eyed	197, 407	268, 851	292, 535	297, 699	171, 475	209, 10[illegible]
Pike (including pickerel, jacks, and yellow jack)	506, 881	596, 471	593, 234	690, 968	590, 529	623, 86[illegible]
Sablefish (black cod)	1, 854, 549	1, 312, 789	955, 200	774, 558	615, 619	499, 44[illegible]
Salmon, chinook	958, 353	660, 986	568, 535	439, 847	369, 376	457, 87[illegible]
Salmon, silver	4, 008, 512	2, 705, 577	1, 687, 600	837, 109	477, 510	470, 65[illegible]
Salmon, fall and pink	1, 571, 953	705, 652	706, 094	510, 118	385, 750	259, 12[illegible]
Salmon, steelhead trout	254, 462	120, 812	135, 205	51, 292	46, 200	50, 014
Salmon, all other	1, 215, 085	1, 095, 706	830, 885	646, 604	586, 881	739, 83[illegible]
Scup (porgies)	572, 087	427, 727	224, 569	116, 350	213, 936	586, 425
Shad and shad roe	482, 808	383, 559	230, 023	155, 004	218, 127	370, 061
Shellfish	2, 781, 906	2, 866, 164	2, 334, 026	1, 768, 016	1, 505, 485	1, 562, 262
Smelts, eulachon, etc	648, 125	1, 049, 351	1, 341, 806	881, 686	659, 519	672, 410
Squid	3, 425, 055	2, 818, 948	2, 044, 533	1, 402, 360	1, 901, 130	3, 358, 468
Sturgeon and spoonbill cat	668, 311	793, 505	1, 189, 013	1, 209, 417	1, 098, 911	1, 000, 968
Suckers	63, 487	33, 902	43, 520	49, 004	56, 214	114, 572
Weakfish (including southern "sea trout")	2, 170, 424	1, 459, 072	814, 309	402, 089	433, 113	655, 569
Whitefish	1, 233, 902	1, 878, 637	1, 752, 145	1, 558, 674	1, 214, 435	1, 276, 064
Whiting	5, 810, 756	4, 051, 263	3, 042, 907	2, 076, 412	1, 502, 942	2, 248, 107
Miscellaneous frozen fish	7, 102, 240	5, 546, 334	4, 029, 596	4, 531, 924	4, 335, 047	5, 380, 755
Total	62, 374, 544	48, 364, 486	37, 744, 416	31, 686, 525	30, 173, 896	40, 147, 83[illegible]

Species	Month ended the 15th of—					
	July	August	September	October	November	December
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Bluefish (all trade sizes)	473, 065	762, 497	783, 669	743, 585	653, 330	560, 066
Butterfish (all trade sizes)	2, 193, 142	2, 340, 510	2, 470, 855	2, 307, 558	2, 353, 034	2, 107, 894
Catfish	158, 465	339, 602	364, 015	321, 533	376, 553	433, 773
Cisco (Lake Erie)	59, 929	89, 117	200, 039	175, 364	140, 880	193, 010
Cisco (lake herring), including bluefin, blackfin, and chub	198, 756	388, 814	814, 576	937, 220	1, 813, 260	2, 323, 970
Cisco (tullibees, Canadian lakes)	1, 391, 983	1, 247, 417	1, 181, 430	1, 035, 587	1, 065, 203	1, 250, 922
Cod, haddock, hake, pollock	3, 679, 178	5, 393, 924	6, 399, 973	5, 312, 277	4, 920, 893	4, 067, 218
Croaker	869, 456	1, 783, 136	1, 854, 297	1, 247, 278	1, 072, 221	918, 466
Flounders	872, 975	851, 489	839, 311	818, 606	870, 433	826, 847
Halibut (all trade sizes)	7, 852, 695	9, 449, 486	11, 261, 256	12, 287, 584	10, 437, 287	9, 719, 089
Herring, sea (including alewives and bluebacks)	1, 458, 656	1, 815, 693	2, 124, 864	2, 080, 863	3, 025, 748	3, 213, 599
Lake trout	440, 405	624, 712	791, 954	1, 078, 635	2, 012, 501	1, 854, 634
Mackerel (except Spanish)	6, 074, 849	7, 224, 971	8, 176, 234	10, 397, 493	9, 583, 361	8, 091, 395
Pike, blue and sauger	405, 742	368, 509	402, 904	712, 325	1, 062, 145	1, 192, 775
Pike, yellow or wall-eyed	309, 497	308, 832	346, 420	477, 349	564, 086	531, 577
Pike (including pickerel, jacks, and yellow jack)	456, 842	417, 302	480, 428	540, 056	868, 178	764, 296
Sablefish (black cod)	585, 019	683, 024	802, 706	1, 114, 423	1, 803, 338	1, 794, 605
Salmon, chinook	817, 145	1, 071, 368	1, 262, 124	1, 293, 093	1, 296, 485	1, 239, 115
Salmon, silver	753, 968	2, 023, 946	2, 693, 937	3, 618, 463	3, 940, 831	3, 493, 174
Salmon, fall and pink	237, 826	547, 602	638, 981	1, 248, 103	2, 314, 838	2, 151, 655
Salmon, steelhead trout	307, 329	457, 039	576, 796	449, 281	347, 982	271, 112
Salmon, all other	1, 066, 742	1, 385, 325	1, 655, 696	1, 930, 938	1, 848, 333	1, 568, 708
Scup (porgies)	722, 549	951, 607	1, 005, 181	926, 378	857, 862	767, 790
Shad and shad roe	353, 001	426, 710	463, 232	427, 185	401, 250	455, 124
Shellfish	1, 528, 045	1, 378, 097	1, 486, 857	1, 636, 129	2, 151, 829	2, 195, 211

Holdings of frozen fishery products, by species and months, 1929—Continued

Species	Month ended ths 15th of—					
	July	August	September	October	November	December
	Pounds	*Pouuds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Smelts, eulachon, etc	717,766	692,025	690,055	678,626	645,234	552,003
Squid	3,288,473	3,238,577	2,959,612	2,495,997	2,033,842	1,792,097
Sturgeon and spoonbill cat	956,035	952,968	936,320	850,283	1,269,854	1,191,194
Suckers	112,364	103,006	117,347	130,406	132,501	110,038
Weakfish (including southern "sea trout")	867,768	1,212,191	1,605,817	1,587,693	1,521,186	1,471,006
Whitefish	1,377,073	1,596,366	1,617,843	1,535,800	1,899,025	1,864,152
Whiting	4,432,686	6,010,146	5,660,185	5,270,222	5,691,549	5,935,788
Miscellaneous frozen fish	6,644,280	8,673,908	10,008,868	10,197,369	10,463,694	10,904,686
Total	51,663,704	64,809,916	72,673,782	75,863,702	79,438,746	75,806,989

Monthly holdings of frozen fishery products for 1929 and 1928, and the 5-year average, compared

[Expressed in thousands of pounds; that is, 000 omitted]

Month ended the 15th of—	1929	1928	5-year average	Increase (+) or decrease (−)	
				Compared with 1928	Compared with 5-year average
				Per cent	*Per cent*
January	62,375	53,921	53,738	+16	+16
February	48,364	44,877	43,080	+8	+12
March	37,744	34,528	30,750	+9	+23
April	31,687	26,473	22,258	+20	+42
May	30,174	26,513	24,684	+14	+22
June	40,148	40,946	33,617	−2	+19
July	51,664	53,140	43,472	−3	+19
August	64,810	66,170	54,872	−2	+18
September	72,674	71,352	61,676	+2	+18
October	75,864	73,410	67,014	+3	+13
November	79,439	77,677	70,351	+2	+13
December	75,807	78,090	67,819	−3	+12
Average	55,896	53,925	47,778	+4	+17

Monthly holdings of frozen fishery products, 1929, by geographical sections [1]

[Expressed in thousands of pounds; that is, 000 omitted]

Month ended the 15th of	New England	Middle Atlantic	South Atlantic	North Central, East	North Central, West	South Central	Pacific [2]	Total
January	15,424	18,702	2,289	10,434	4,006	569	10,951	62,375
February	10,569	16,365	1,709	8,878	3,618	563	6,662	48,364
March	6,804	13,447	892	7,087	3,444	474	5,596	37,744
April	4,684	11,078	1,199	5,896	3,224	675	4,931	31,687
May	4,944	9,740	722	4,953	2,746	608	6,461	30,174
June	8,908	12,266	1,056	6,162	2,769	724	8,263	40,148
July	16,061	13,154	1,651	6,065	2,782	779	11,172	51,664
August	22,357	14,708	2,746	6,094	3,097	1,039	14,769	64,810
September	25,042	15,636	3,158	6,632	3,327	1,060	17,819	72,674
October	24,523	15,814	2,536	7,643	3,544	856	20,948	75,864
November	23,760	17,458	2,596	9,803	4,670	907	20,245	79,439
December	19,804	18,745	3,169	10,974	4,862	987	17,266	75,807
Average	15,241	14,759	1,977	7,552	3,507	770	12,090	55,896

[1] New England includes the 6 States of that section: Middle Atlantic—New York, New Jersey, and Pennsylvania; South Atlantic—Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, and Florida; North Central, East—Ohio, Indiana, Illinois, Michigan, and Wisconsin; North Central, West—Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas; South Central—Kentucky, Tennessee, Alabama, Mississippi, Louisiana, Texas, Oklahoma, and Arkansas; Pacific—Washington, Oregon, California, and Alaska.

[2] Includes a very small amount of fish held in Colorado in the mountain section.

It is interesting to note the comparison of the holdings of various important species during the year 1929 with the normal (average 1924–1928) holdings of these stocks. With the ground fish group it is found that during each month in 1929 the holdings were consistently above normal. Those of lake trout were above normal during the first five months of the year, below normal until October, and from then on during the remainder of the year they were practically the same as in a normal year. The monthly holdings of sea herring were consistently lower throughout the year than the normal monthly holdings in spite of the fact that greater quantities of herring were frozen in 1929 than the previous year. Those of squid were above normal during this year until September, and from then on they were slightly below normal. Those of whiting followed a normal course practically throughout the entire year. Those of mackerel were above normal throughout the entire year, although they nearly approached normal during the months from May to September, inclusive. Those of halibut were lower than normal during every month of the year, while those of salmon followed the normal course until about June, and from then on were slightly below normal during the remainder of the year.

Monthly holdings of certain species of frozen fish in 1929 and normal monthly holdings (average 1924–1928)

Species	Month ended the 15th of—					
	January	February	March	April	May	June
Cod, haddock, hake, pollock:	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Normal	1, 268, 000	970, 000	745, 000	635, 000	835, 000	990, 000
1929	2, 957, 609	1, 482, 275	1, 068, 767	1, 486, 011	2, 021, 324	2, 969, 942
Halibut (all trade sizes):						
Normal	6, 959, 000	4, 483, 000	3, 250, 000	3, 411, 000	4, 613, 000	6, 617, 000
1929	4, 747, 250	2, 868, 110	2, 171, 749	2, 351, 050	4, 123, 865	5, 932, 809
Herring, sea (including alewives and bluebacks):						
Normal	3, 010, 000	2, 794, 000	2, 557, 000	1, 836, 000	2, 253, 000	2, 396, 000
1929	2, 196, 315	1, 846, 071	1, 963, 822	1, 694, 690	1, 675, 950	1, 714, 353
Lake trout:						
Normal	1, 613, 000	1, 246, 000	793, 000	377, 000	383, 000	503, 000
1929	1, 878, 725	1, 342, 644	799, 555	562, 859	449, 751	462, 816
Mackerel (except Spanish):						
Normal	4, 322, 000	3, 263, 000	2, 002, 000	1, 030, 000	1, 444, 000	2, 875, 000
1929	7, 456, 437	5, 884, 517	3, 993, 333	2, 435, 463	1, 574, 300	2, 886, 128
Salmon (all species, including steelhead trout):						
Normal	7, 128, 000	5, 426, 000	3, 414, 000	2, 408, 000	1, 921, 000	2, 250, 000
1929	8, 008, 365	5, 288, 733	3, 928, 319	2, 484, 970	1, 865, 717	1, 977, 502
Squid:						
Normal	1, 245, 000	944, 000	703, 000	318, 000	549, 000	2, 022, 000
1929	3, 425, 055	2, 818, 948	2, 044, 533	1, 402, 360	1, 901, 130	3, 358, 468
Whiting:						
Normal	3, 973, 000	2, 719, 000	1, 542, 000	1, 064, 000	914, 000	2, 269, 000
1929	5, 810, 756	4, 051, 263	3, 042, 907	2, 076, 412	1, 502, 942	2, 248, 107

Monthly holdings of certain species of frozen fish in 1929 and normal monthly holdings (average 1924–1928)—Continued

Species	July	August	September	October	November	December
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Cod, haddock, hake, pollock:						
Normal	1, 129, 000	1, 479, 000	1, 952, 000	2, 269, 000	2, 213, 000	1, 972, 000
1929	3, 679, 178	5, 393, 924	6, 399, 973	5, 312, 277	4, 920, 893	4, 067, 218
Halibut (all trade sizes):						
Normal	8, 542, 000	11, 155, 000	12, 678, 000	12, 672, 000	11, 707, 000	9, 970, 000
1929	7, 852, 695	9, 449, 486	11, 261, 256	12, 287, 584	10, 437, 287	9, 719, 089
Herring, sea (including alewives and bluebacks):						
Normal	2, 389, 000	2, 606, 000	2, 667, 000	3, 009, 000	3, 381, 000	3, 449, 000
1929	1, 458, 656	1, 815, 693	2, 124, 864	2, 080, 863	3, 025, 748	3, 213, 599
Lake trout:						
Normal	644, 000	771, 000	836, 000	1, 078, 000	1, 904, 000	2, 083, 000
1929	440, 405	624, 712	791, 954	1, 078, 635	2, 012, 501	1, 854, 634
Mackerel (except Spanish):						
Normal	4, 946, 000	6, 691, 000	7, 827, 000	7, 827, 000	7, 146, 000	6, 161, 000
1929	6, 074, 849	7, 224, 971	8, 176, 234	10, 397, 493	9, 583, 361	8, 091, 395
Salmon (all species, including steelhead trout):						
Normal	3, 820, 000	6, 057, 000	7, 751, 000	10, 188, 000	10, 573, 000	9, 505, 000
1929	3, 183, 010	5, 485, 280	6, 827, 534	8, 539, 878	9, 748, 469	8, 723, 764
Squid:						
Normal	2, 405, 000	2, 606, 000	2, 523, 000	2, 662, 000	2, 528, 000	2, 171, 000
1929	3, 288, 473	3, 238, 577	2, 959, 612	2, 495, 997	2, 033, 842	1, 792, 097
Whiting:						
Normal	4, 413, 000	5, 986, 000	5, 986, 000	5, 630, 000	5, 770, 000	5, 454, 000
1929	4, 432, 686	6, 010, 146	5, 660, 185	5, 270, 222	5, 691, 549	5, 935, 788

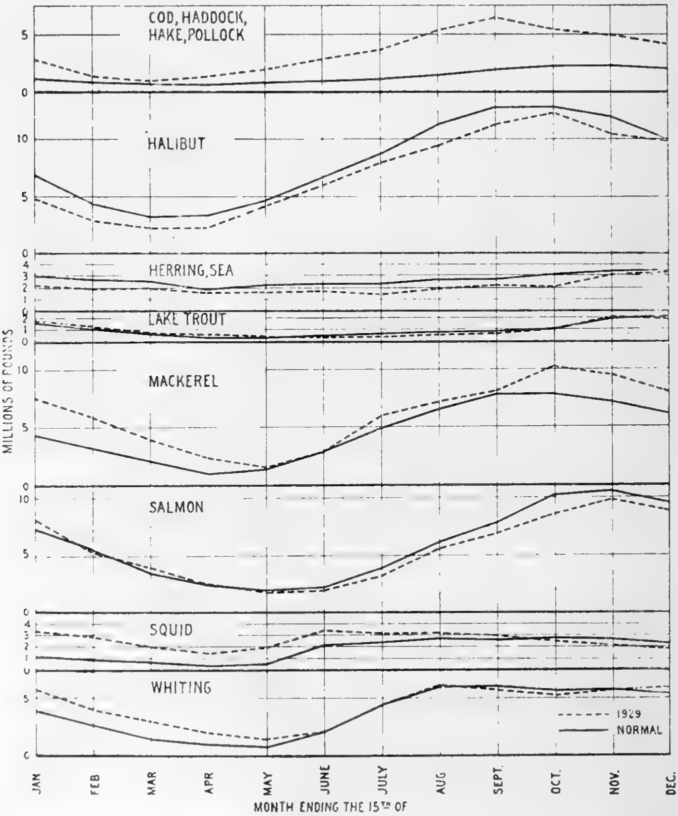

FIGURE 13.—Monthly holdings of certain species of frozen fish in 1929 and normal monthly holdings (average 1924 to 1928)

HOLDINGS OF CURED FISH

Only cured herring and mild-cured salmon are reported held in cold-storage warehouses in the United States and Alaska during 1929. Monthly holdings of cured herring varied between 18,900,000 pounds in February and 24,600,000 pounds in September. Monthly holdings of mild-cured salmon varied between 1,800,000 pounds in May, and 7,200,000 pounds in September. The stocks of cured fish held in cold storage in 1929 were considerably larger than those during the year 1928, and considerably above normal. The monthly holdings in 1929 compared with normal show increases during 10 months of the year of from 2 to 47 per cent, and decreases of 2 and 8 per cent during only 2 months of the year. Compared with the respective monthly holdings in 1928 there were increases in 11 months, ranging from 6 to 59 per cent. In only 1 month was there a decrease, that being 3 per cent in December.

Holdings of cured fish, 1929, by species and months

Month ended the 15th of—	Cured herring	Mild-cured salmon	Total
	Pounds	*Pounds*	*Pounds*
January	19,439,346	4,219,251	23,658,597
February	18,897,121	3,240,579	22,137,700
March	19,090,635	2,314,514	21,405,149
April	23,246,667	1,934,272	25,180,939
May	23,560,584	1,798,720	25,359,304
June	23,852,080	2,826,187	26,678,267
July	23,513,036	4,828,686	28,341,722
August	22,730,960	5,896,780	28,627,740
September	24,569,135	7,191,949	31,761,084
October	23,802,003	6,946,221	30,748,224
November	21,357,017	6,690,832	28,047,849
December	19,557,194	5,419,722	24,976,916

Monthly holdings of cured fish for 1929 and 1928 and the 5-year average, compared

[Expressed in thousands of pounds; that is, 000 omitted]

Month ended the 15th of—	1929	1928	5-year average	Increase (+) or decrease (−) Compared with 1928	Compared with 5-year average
				Per cent	*Per cent*
January	23,659	22,384	23,306	+6	+2
February	22,138	19,955	21,063	+11	+5
March	21,405	16,508	18,646	+30	+15
April	25,181	16,564	18,270	+52	+38
May	25,359	16,076	17,225	+58	+47
June	26,678	16,781	18,546	+59	+44
July	28,342	18,279	19,781	+55	+43
August	28,628	20,494	23,240	+40	+23
September	31,761	24,655	27,050	+29	+17
October	30,748	26,090	29,461	+18	+4
November	28,048	26,440	28,645	+6	−2
December	24,977	25,772	27,150	−3	−8
Average	26,410	20,833	22,699	+27	+16

FOREIGN FISHERY TRADE

The volume of foreign trade in fishery products of the United States in 1929 amounted to $90,395,769, of which $66,565,599 represents the value of those imported for consumption, and $23,830,170 the value of exports of domestic fishery products. Compared with the previous year, this is an increase of 13 per cent in total trade, an increase of 13 per cent in the value of the imports, and an increase of 13 per cent in the value of exports.

Imports consisted of 357,109,092 pounds of edible products (including fresh, frozen, and cured canned fish and shellfish), valued at $38,752,571, and nonedible products (comprised mainly of marine-animal oils, pearls, and imitation pearls), valued at $27,813,028. Compared with 1928 this is a decrease of 1 per cent in the quantity, and an increase of 4 per cent in the value of edible products imported, and an increase of 30 per cent in the value of nonedible products imported. Increases in the value of edible products imported were due chiefly to larger imports of fresh and frozen fish packed in ice, and various species of shellfish packed in ice, or canned. The increase in the value of nonedible products imported was due almost entirely to the greater value of imitation pearls and pearls that had not been strung or set, although considerable of this is due to the greater imports of marine-animal oils.

Fishery exports consisted of edible products amounting to 213,308,744 pounds valued at $23,500,614, and nonedible products valued at $329,556. Compared with the previous year this is an increase of 25 per cent in the quantity, and 13 per cent in the value of edible products imported, and a decrease of 15 per cent in the value of nonedible products imported. The increase in edible exports is attributed chiefly to the larger exports of canned fish, especially sardines, while the exports of other groups of edible products showed little change from the preceding year. Exports of nonedible products also show but little change from those for 1928.

Considering only the amount of fishery products on which we usually have an unfavorable trade balance, the imports of fresh and frozen fish in 1929 were about 20 times the exports in 1928, which is a slightly lower ratio than in the year previous. In 1929 the imports of cured fish were a little over eight times the exports, which is about the same ratio as a year ago. Imports of fresh and canned shellfish were about two times as great as the exports in 1928, which is about the same ratio as in the preceding three years. Imports of all edible fishery products were about two times the exports, which also is about the same ratio as in the previous year. Imports of marine-animal oils n 1929 were about 124 times the amount of exports in 1928, which is a somewhat lower ratio than the preceding two years, indicating that perhaps our marine-animal oil industries are producing a greater quantity of these oils to take care of the domestic trade.

Contrasting those products with those on which we usually have a favorable trade balance, the volume of the exports of canned fish, which is the most important export group, was nearly five times the imports, which is a somewhat larger ratio than in 1928. Exports of miscellaneous edible fishery products were about three times the quantity of the imports in 1929, which is a somewhat lower ratio than prevailed in_1928.

Considering the total trade, the value of all fishery products imported was about three times the value of all fishery products exported in 1929, which is the same ratio as prevailed in 1928.

Exports of domestic fishery products, 1928 and 1929

Items	1928		1929	
	Quantity	*Value*	*Quantity*	*Value*
Fish, fresh, frozen or packed in ice:				
Salmon .... pounds	3,453,922	$555,316	3,582,174	$545,575
Other fresh fish .... do	4,539,413	405,183	5,231,641	557,960
Total .... do	7,993,335	960,499	8,813,815	1,103,535
Fish, salted or dry cured:				
Cod .... do	3,165,472	361,968	2,936,505	367,477
Haddock, hake and pollock .... do	1,951,305	150,548	1,246,856	101,424
Herring .... do	1,888,759	119,497	2,170,295	138,771
Salmon .... do	4,367,236	975,502	3,789,965	938,471
Other .... do	1,646,358	128,892	1,697,913	196,836
Total .... do	13,019,130	1,736,407	11,841,534	1,742,97[illegible]
Fish, pickled:				
Salmon .... do	1,913,000	502,673	909,000	251,188
Other .... do	932,800	72,045	852,000	56,808
Total .... do	2,845,800	574,718	1,761,000	307,996
Fish, canned:				
Salmon .... do	40,952,705	7,661,733	40,967,378	7,405,941
Sardines .... do	80,253,474	6,522,711	123,920,062	9,418,511
Other .... do	9,362,496	939,288	9,396,718	898,537
Total .... do	130,568,675	15,123,732	174,284,158	17,722,989
Shellfish:				
Canned .... do	4,730,944	1,011,106	4,857,375	1,006,896
Not canned .... do	8,260,959	1,194,194	9,364,783	1,405,785
Total .... do	12,991,903	2,205,300	14,222,158	2,412,681
Other fish products .... do	3,398,571	185,697	2,386,079	210,434
Total edible products .... do	170,817,414	20,786,353	213,308,744	23,500,614
Marine-animal oils .... do	881,820	105,368	1,120,022	94,708
Buttons, pearl, or shell .... gross	454,529	135,504	242,399	82,915
Sponges .... pounds	114,917	146,520	124,443	151,933
Total	....	282,024	....	234,848
Total nonedible products	....	387,392	....	329,556
Grand total	....	21,173,745	....	23,830,170

Imports of fishery products entered for consumption, 1928 and 1929

Items	1928		1929	
	Pounds	*Value*	*Pounds*	*Value*
Edible fishery products:				
Fish, fresh, frozen, or packed in ice—				
Cod, haddock, hake, and pollock	829, 906	$36, 974	1, 036, 046	$67, 408
Eels	891, 000	110, 191	501, 536	73, 839
Fresh-water fishes	52, 458, 338	5, 191, 666	56, 600, 927	5, 617, 282
Halibut	4, 357, 977	490, 653	5, 815, 711	732, 898
Herring (frozen)	2, 219, 299	101, 986	1, 756, 965	89, 583
Herring (fresh sea)	54, 331, 131	344, 212	36, 601, 482	251, 549
Mackerel	2, 169, 342	146, 157	1, 623, 120	96, 757
Salmon	6, 029, 845	683, 181	4, 319, 261	571, 170
Smelts	8, 800, 895	1, 209, 779	6, 952, 489	1, 005, 502
Swordfish	802, 045	132, 371	723, 821	88, 353
Tuna	30, 351, 313	1, 852, 999	50, 695, 484	2, 631, 172
Other dutiable	8, 036, 000	817, 941	7, 516, 479	819, 847
Total	171, 277, 091	11, 118, 110	174, 143, 321	12, 045, 360
Fish, salted, dried, smoked, or pickled—				
Cod, dried	30, 782, 655	2, 556, 509	28, 012, 786	2, 626, 920
Finnan haddie	1, 237, 452	107, 230	1, 056, 106	102, 354
Hake and pollock, dried	1, 884, 404	112, 135	1, 586, 030	99, 465
Herring—				
Dried	1, 036, 843	51, 863	391, 988	22, 149
Pickled or salted	46, 439, 695	3, 064, 147	44, 163, 702	2, 768, 004
Smoked, skinned, or boned	73, 020	7, 811	10, 686	980
Mackerel, pickled or salted	8, 130, 849	568, 700	7, 883, 422	606, 782
Salmon, dried	4, 225	443	1, 460	300
Salmon, kippered, smoked, salted, pickled, or otherwise prepared	820, 470	95, 353	769, 734	128, 041
Other kippered, smoked, salted, pickled, or otherwise prepared, not elsewhere specified	25, 464, 235	2, 338, 707	25, 219, 712	2, 526, 026
Other dried fish	5, 289, 517	712, 998	4, 408, 240	615, 867
Others in bulk or packages	3, 233, 555	365, 303	992, 899	135, 603
Total	124, 396, 920	9, 981, 199	114, 496, 765	9, 632, 491
Fish packed in oil or other substances—				
Sardines	29, 243, 293	5, 154, 491	31, 389, 716	5, 550, 902
All others	5, 132, 731	1, 336, 825	5, 135, 207	1, 301, 533
Total	34, 376, 024	6, 491, 316	36, 524, 923	6, 852, 435
Fish roe, frozen, prepared, or preserved—				
Caviar	472, 257	825, 368	487, 046	793, 360
Other fish roe, preserved	299, 492	56, 598	331, 476	65, 308
Total	771, 749	881, 966	818, 522	858, 668
Shellfish—				
Crabs	76, 660	14, 879	203, 825	16, 415
Crab meat packed in ice, frozen, or otherwise prepared or preserved	12, 506, 130	4, 897, 835	10, 346, 999	4, 646, 504
Lobsters, canned	1, 605, 881	1, 004, 472	1, 490, 194	936, 959
Lobsters (other than canned), fresh, frozen, packed in ice, or prepared or preserved in any manner (not specially provided for)	6, 537, 792	1, 720, 850	8, 628, 826	2, 231, 298
Turtles	670, 501	38, 041	632, 674	33, 396
Other shellfish and shrimp	8, 548, 262	1, 242, 411	9, 823, 043	1, 499, 045
Total	29, 945, 226	8, 918, 488	31, 125, 561	9, 363, 617
Total edible fishery products	360, 767, 010	37, 391, 079	357, 109, 092	38, 752, 571
Nonedible fishery products:	*Quantity*		*Quantity*	
Marine-animal oils—				
Cod oil ... gallons	1, 569, 234	801, 278	2, 090, 818	1, 019, 582
Cod-liver oil ... do	2, 571, 936	2, 522, 672	2, 860, 728	2, 448, 162
Herring, menhaden, and sod oil ... do	5, 116, 716	1, 784, 293	4, 628, 428	1, 803, 803
Other fish oils ... do	316, 471	92, 080	465, 859	144, 383
Seal oil ... do	194, 794	86, 407	630, 778	281, 021
Whale oil, sperm ... do	442, 041	167, 776	346, 621	145, 916
Whale oil, other ... do	6, 456, 866	3, 021, 378	7, 540, 329	3, 529, 021
Total ... do	16, 668, 058	8, 475, 884	18, 563, 561	9, 371, 888
Pearls and imitation pearl—				
Pearls and parts, not strung or set		7, 083, 654		10, 345, 420
Imitation half pearls and hollow or filled pearls, without holes or with holes partly through		165, 499		68, 655
Imitation solid pearls, wholly or partly pierced, mounted or unmounted		40, 298		30, 015
Imitation pearl beads		1, 352, 115		1, 373, 395
Total		8, 641, 566		11, 817, 485

Imports of fishery products entered for consumption, 1928 and 1929—Continued

Items	1928		1929	
	Pounds	Value	Pounds	Value
Nonedible fishery products—Continued.				
Shells and buttons of pearl or shell—				
Shells, not manufactured:				
Green snail shell .... pounds	104,675	$12,698	189,601	$36,263
Mother-of-pearl .... do	6,516,745	1,882,556	8,924,262	2,574,523
All others .... do	2,280,987	257,313	8,579,352	306,490
Shells, manufactured		72,558		60,433
Shell pearl buttons:				
Fresh water .... gross	3,015	1,344	1,765	1,057
Ocean or trochus .... do	118,758	45,375	133,902	52,868
Buttons, blanks, not turned, faced, or drilled .... gross	3,072	1,640		
Buttons (from Philippine Islands) .... gross	922,219	438,100	670,775	365,694
Total		2,711,584		3,397,328
Sponges .... pounds	933,232	1,124,297	856,515	1,091,129
Agar-agar .... do	397,368	285,659	502,626	405,728
Ambergris .... do	160	46,297	387	125,908
Cuttlefish bone .... do	287,403	35,870	361,707	46,920
Fish for purposes other than human consumption .... pounds	3,678,684	61,633		62,560
Fish skins, raw or salted .... do	745,880	29,440	2,984,094	1,434,489
Fish sounds, crude, dried, or salted for preservation only .... pounds	39,705	6,507	134,918	17,683
Sea grass, eelgrass, and seaweed, dyed or manufactured		44,636		38,350
Whalebone, unmanufactured .... pounds	350	456	3,154	1,878
Whalebone, manufactures of .... do	1	30	Not reported.	1,682
Total		510,528		2,135,198
Total nonedible fishery products		21,463,859		27,813,028
Grand total		58,854,938		66,565,599

Imports for consumption and domestic exports of fishery products, 1929, and ratio comparisons

Items	Imports		Exports		Ratio of imports to exports	
	Pounds	Value	Pounds	Value	Quantity	Value
Edible fishery products:						
Fish, fresh, frozen, or packed in ice	174,143,321	$12,045,360	8,813,815	$1,103,535	198:10	109:10
Fish, salted, dried, smoked, or pickled	114,496,765	9,632,491	13,602,534	2,050,975	84:10	47:10
Fish, canned or packed in oil	36,524,923	6,852,435	174,284,158	17,722,989	10:48	10:26
Shellfish, canned or fresh	31,125,561	9,363,617	14,222,158	2,412,681	22:10	39:10
Other fish products, roe, caviar, etc	818,522	858,668	2,386,079	210,434	10:29	41:10
Total	357,109,092	38,752,571	213,308,744	23,500,614	17:10	16:10
Nonedible fishery products:						
Marine-animal oils [1]	139,226,708	9,371,888	1,120,022	94,708	1,243:10	990:10
All other		18,441,140		234,848		785:10
Total		27,813,028		329,556		844:10
Grand total		66,565,599		23,830,170		28:10

[1] Gallon of marine-animal oil calculated at 7.5 pounds.

FISHERIES OF THE NEW ENGLAND STATES

During 1928 the value of the catch of fishery products in the New England States (Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut) exceeded that in any year for which there are records. This was due mainly to the increased production of haddock. These fisheries gave employment to 16,659 fishermen or

11 per cent more than in 1924, the most recent year for which records are available prior to 1928. Of the total number of fishermen employed during 1928, 5,649 regular fishermen were engaged on vessels, and 9,233 regular and 1,777 casual fishermen were employed in the shore and boat fisheries. Their catch amounted to 603,598,050 pounds, valued at $25,619,904. This is an increase of 48 per cent in the catch and 36 per cent in the value of the catch as compared with the quantity and its value for 1924. Of the total catch in 1928, 561,103,967 pounds, valued at $18,103,467, were fish, and 42,494,083 pounds, valued at $7,516,437, were shellfish and miscellaneous products.

Based on the value to the fishermen, haddock with a production of 237,707,820 pounds, valued at $7,047,591, was the most important product. Lobsters were second with a production of 11,603,979 pounds, valued at $3,413,881. Other products of importance were cod, 90,335,557 pounds, valued at $2,955,603; flounders, 50,274,092 pounds, valued at $2,259,077; mackerel, 42,722,006 pounds, valued at $2,185,462; oysters, 9,373,249 pounds of meats, valued at $1,883,663; and all varieties of clams, 7,750,280 pounds of meats, valued at $1,220,086. Other products were valued individually at less than $1,000,000.

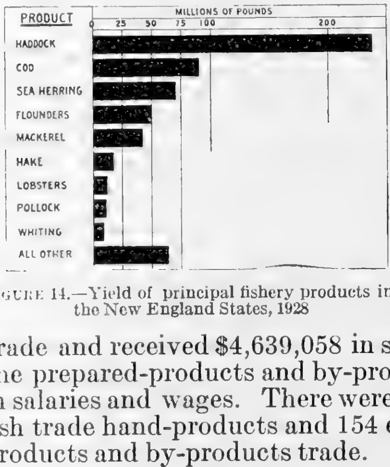

FIGURE 14.—Yield of principal fishery products in the New England States, 1928

The industries related to the fisheries of the New England States gave employment to 7,885 persons, of whom 382 were engaged in transporting fishery products, 3,057 were in the wholesale trade and received $4,639,058 in salaries and wages, and 4,446 were in the prepared-products and by-products trade and received $3,657,086 in salaries and wages. There were 302 establishments in the wholesale fish trade hand-products and 154 establishments were in the prepared-products and by-products trade. The latter manufactured products—mostly canned sardines, clams, and other canned fishery products—to the value of $16,934,487. In addition, individual fishermen in the New England States prepared fishery products valued at $162,154. Most of these products were salt fish prepared from the various species of ground fish.

Fisheries of the New England States, 1928

SUMMARY OF CATCH

Products	Maine		New Hampshire		Massachusetts	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Fish	111,998,075	$1,872,538	109,000	$4,750	363,406,942	$12,921,051
Shellfish, etc.	11,328,080	2,358,553	130,099	40,785	16,761,417	2,727,725
Total	123,326,155	4,231,091	239,099	45,535	380,168,359	15,648,776

Products	Rhode Island		Connecticut		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Fish	19,431,714	$1,053,364	66,158,236	$2,251,764	561,103,967	$18,103,467
Shellfish, etc.	8,234,439	1,344,527	6,040,048	1,044,847	42,494,083	7,516,437
Total	27,666,153	2,397,891	72,198,284	6,296,311	603,598,050	25,619,904

Fisheries of the New England States, 1928—Continued

OPERATING UNITS: BY STATES

Items	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	478		4,152	263	756	5,649
On boats and shore—						
Regular	4,315	41	3,275	731	871	9,233
Casual	803	12	324	265	373	1,777
Total	5,596	53	7,751	1,259	2,000	16,659
Vessels:						
Steam			22	10	25	57
Net tonnage			3,405	285	4,345	8,035
Motor	84		397	73	91	645
Net tonnage	1,066		12,775	760	1,185	15,786
Sail			1		5	6
Net tonnage			152		36	188
Total vessels	84		420	83	121	708
Total net tonnage	1,066		16,332	1,045	5,566	24,009
Boats:						
Motor	2,788	38	1,957	526	532	5,841
Other	2,906	38	1,859	468	506	5,777
Accessory boats	288		873	27	10	1,198
Apparatus:						
Purse seines—						
Menhaden				1	2	3
Yards				400	930	1,330
Other	62		106	8	13	189
Yards	16,651		52,715	1,000	850	71,216
Haul seines, common	146		10	15	85	256
Yards	29,400		520	1,485	4,017	35,422
Gill nets—						
Drift	248		7,677	246	41	8,212
Square yards	84,432		2,059,774	96,422	99,500	2,340,128
Stake	13				26	39
Square yards	1,512				3,300	4,812
Anchor	1,927		902	8		2,837
Square yards	514,760		252,160	1,200		768,120
Runaround				1		1
Square yards				12,000		12,000
Lines—						
Trawl	40,906	100	49,932	470	11,100	102,508
Hooks	2,061,218	5,000	2,453,480	27,440	555,000	5,102,138
Hand	4,198	48	731	224	189	5,390
Hooks	5,184	192	1,646	232	374	7,628
Pound nets	1		121	64	25	211
Floating traps	35		25	58		118
Weirs	301				5	306
Fyke nets	122		92	63	186	463
Dip nets	73		45	13	48	179
Bag nets	139					139
Pocket nets	7					7
Otter trawls	41		379	77	178	675
Yards at mouth	833		10,288	2,021	2,020	15,162
Box traps	4				2	6
Pots—						
Crab	74		2,315		60	2,449
Eel	343		1,678	1,565	1,687	5,273
Lobster	210,832	2,380	61,687	36,925	22,750	334,574
Periwinkle and cockle			400	300		700
Harpoons, swordfish	79		108	47	18	252
Spears	33		86	38	45	202
Dredges—						
Oyster			56	35	216	307
Yards at mouth			68	50	235	353
Scallop	107		3,230	290		3,627
Yards at mouth	167		3,521	238		3,926
Clam			211			211
Yards at mouth			220			220
Tongs			125	209	65	399
Rakes			498	93	81	672
Forks	1,040		22			1,062
Hoes	281		482	3		766
Grapple irons, kelp	1					1

Fisheries of the New England States, 1928—Continued

CATCH: BY STATES

Species	Maine		New Hampshire		Massachusetts		Rhode Island		Connecticut		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
FISH												
Alewives	2,131,916	$19,001			2,247,972	$29,298	161,410	$3,355	15,680	$300	4,556,978	$51,954
Bluefish	140	19			14,516	1,699	35,378	5,901	5,250	1,534	55,284	9,153
Bonito	845	36			18,465	1,955	48,950	4,884			68,260	6,875
Butterfish	25,339	2,864			580,397	79,997	928,943	108,472	13,884	1,524	1,548,563	192,857
Carp									14,395	1,749	14,395	1,749
Catfish and bullheads									1,200	77	1,200	77
Cod	16,186,739	434,963	25,000	$750	67,665,689	2,268,375	2,256,989	118,989	4,201,140	132,526	90,335,557	2,955,603
Cunners	10,000	500			30	2	76,255	2,198			86,285	2,700
Cusk	959,759	21,704	10,000	200	2,185,262	51,569			75,024	18,000	3,230,045	91,473
Eels	141,650	12,739			356,149	42,305	253,800	27,859	93,766	13,555	845,365	96,458
Flounders	1,175,313	61,543	4,000	200	36,685,927	1,640,674	4,400,942	199,783	8,007,910	356,877	50,274,092	2,259,077
Frigate mackerel							5,336	349			5,336	349
Goosefish							43,130	907			43,130	907
Grayfish	100,000	2,000			68,210	818	27,599	294	10,500	200	206,309	3,312
Haddock	12,203,984	337,125	50,000	2,000	177,577,775	5,230,961	576,787	17,194	47,299,274	1,460,311	237,707,820	7,047,591
Hake	7,681,461	106,890	10,000	200	9,321,072	204,669	112,477	3,717	381,200	6,352	17,506,210	321,828
Halibut	191,341	30,825			4,060,713	606,150	376	34	4,080	6,112	4,256,510	643,121
Herring, sea	64,685,474	397,777			5,645,538	72,509	221,440	4,261	2,800	70	70,555,252	474,617
Hickory shad					25	2	9,590	557	200	30	9,815	589
King whiting					98	14	2,955	156			3,053	170
Mackerel	1,595,816	71,921			37,161,091	1,862,939	2,696,199	158,744	1,268,900	91,858	42,722,006	2,185,462
Menhaden					4,356	48	1,726,650	17,267	3,443,900	55,840	5,174,906	73,155
Minnows									17,707	5,214	17,707	5,214
Mummichog									6,610	1,123	6,610	1,123
Pike									10	2	10	2
Pollock	2,876,481	37,943	5,000	150	7,700,726	168,783	166,751	8,517	290,425	8,168	11,039,383	223,561
Rosefish	2,420	47			123,388	1,883					125,808	1,930
Salmon	14,747	5,288			16,050	710	92	28	12	6	30,901	6,032
Sand launce					312,680	3,327					312,680	3,327
Scup					855,272	34,660	2,003,366	156,765	200	4	2,858,838	191,429
Sea bass					154,281	15,549	72,050	7,202	2,170	441	228,501	23,192
Sea robin					350	3	468,147	4,288	13,600	136	482,097	4,427
Shad	110,149	7,755			30,911	2,322	5,681	453	199,063	27,413	345,804	37,943
Sharks	45,438	619			81,918	7,905	16,800	163	1,000	10	145,156	8,697
Skates	75	11			32,918	620	620,830	9,635	404,500	4,193	1,058,323	14,459
Skipper or "billfish"					12,850	954	300	105			13,150	1,059
Smelt	832,216	176,189	5,000	1,250	32,356	4,423	16,718	3,481	16,791	2,226	903,081	187,569
Spot							5,120	343			5,120	343
Squeteagues					3,426	498	70,132	4,610	40,585	10,484	114,143	15,592
Striped bass					8,357	1,511	44,347	6,880	3,817	956	56,521	9,347
Sturgeon	652	87			2,838	567	125	19	202	26	3,817	699
Suckers	62,560	6,256					32	3	63,231	4,605	125,823	10,864

Swordfish	693,071	127,585			2,730,085	481,016	774,324	139,428	168,442	31,109	4,365,922	779,138
Tautog					151,931	12,980	153,868	11,002	89,463	8,712	395,262	32,694
Tomcod	21,204	841			585	29	5,380	169			27,169	1,039
Tuna or horse mackerel	207,270	9,313			35,642	3,445	42,818	3,959			285,730	16,717
Whitebait							300	105			300	105
White perch					10,400	1,560	1,946	270	50	4	12,396	1,834
Whiting	3,510	34			6,995,830	70,967	1,377,216	21,013	1,200	12	8,377,756	92,026
Wolffish	38,305	643			520,813	13,350	165	5			559,283	13,998
Yellow perch	200	20			50	5			55	5	305	30
Total	111,998,075	1,872,538	109,000	4,750	363,406,942	12,921,051	19,431,714	1,053,364	66,158,236	2,251,764	561,103,967	18,103,467
SHELLFISH, ETC.												
Crabs, hard	158,900	4,698			3,139,119	71,567	274,667	8,868	180,750	6,284	3,753,436	91,417
Crabs, soft									1,065	400	1,065	400
Lobsters	7,100,332	2,013,451	130,099	40,785	2,042,331	761,561	1,637,659	357,103	693,558	240,981	11,603,979	3,413,881
Shrimp					1,200	900					1,200	900
Squid	27,090	393			5,540,424	117,522	2,310,604	37,122	49,400	1,666	7,927,518	156,703
Clams, cockle	3,000	180			6,870	2,917					9,870	3,097
Clams, hard, public					1,661,416	524,999	539,776	199,610	29,808	11,188	2,231,000	735,797
Clams, hard, private									1,200	450	1,200	450
Clams, razor					38,400	8,000					38,400	8,000
Clams, soft, public	3,620,580	228,756			1,797,090	233,237	13,830	2,966	38,310	7,783	5,469,810	472,742
Mussels							130,000	1,300			130,000	1,300
Oysters, market, public							1,400	400	14,070	4,080	15,470	4,480
Oysters, market, private					753,949	365,504	2,922,997	656,459	845,964	199,174	4,522,910	1,221,137
Oysters, seed, public									404,649	57,807	404,649	57,807
Oysters, seed, private					324,730	44,428	323,946	40,777	3,781,274	515,034	4,429,950	600,239
Periwinkles	2,000	500			10,250	1,600	6,720	1,344			18,970	3,444
Scallops, bay					1,235,304	548,348	42,870	28,588			1,278,174	576,936
Scallops, sea	326,178	110,125			119,124	42,580	29,970	9,990			475,272	162,695
Irish moss					91,210	4,562					91,210	4,562
Kelp	90,000	450									90,000	450
Total	11,328,080	2,358,553	130,099	40,785	16,761,417	2,727,725	8,234,439	1,344,527	6,040,048	1,044,847	42,494,083	7,516,437
Grand total	123,326,155	4,231,091	239,099	45,535	380,168,359	15,648,776	27,666,153	2,397,891	72,198,284	3,296,611	603,598,050	25,619,904

Fisheries of the New England States, 1928—Continued

PRODUCTION OF CERTAIN SHELLFISH SHOWN IN NUMBERS AND BUSHELS

Products	Maine		Massachusetts		Rhode Island		Connecticut		Total	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Crabs, hard ...number	476, 700	$4, 698	9, 417, 357	$71, 567	824, 001	$8, 868	542, 250	$6, 284	11, 260, 308	$91, 417
Crabs, soft ...do							3, 195	400	3, 195	400
Clams, cockle ...bushels	300	180	687	2, 917					987	3, 097
Clams, hard, public ...bushels			207, 677	524, 999	67, 472	199, 610	3, 726	11, 188	278, 875	735, 797
Clams, hard, private ...bushels							150	450	150	450
Clams, razor ...do			3, 840	8, 000					3, 840	8, 000
Clams, soft, public ...bushels	362, 058	228, 756	179, 709	233, 237	1, 383	2, 966	3, 831	7, 733	546, 981	472, 742
Mussels ...do					13, 000	1, 300			13, 000	1, 300
Oysters, market, public ...bushels					200	400	2, 010	4, 080	2, 210	4, 480
Oysters, market, private ...bushels			107, 707	365, 504	417, 571	656, 459	120, 852	199, 174	646, 130	1, 221, 137
Oysters, seed, public ...bushels							57, 807	57, 807	57, 807	57, 807
Oysters, seed, private ...bushels			46, 390	44, 428	46, 278	40, 777	540, 182	515, 034	632, 850	600, 239
Periwinkles ...do	200	500	1, 025	1, 600	672	1, 344			1, 897	3, 444
Scallops, bay ...do			205, 884	548, 348	7, 145	28, 588			213, 029	576, 936
Scallops, sea ...do	54, 363	110, 125	19, 854	42, 580	4, 995	9, 990			79, 212	162, 695

Industries related to the fisheries of the New England States, 1928

Items	Maine [1]	Massachusetts	Rhode Island	Connecticut	Total
Transporting:	*Number*	*Number*	*Number*	*Number*	*Number*
Persons engaged	263	78	34	7	382
Vessels—					
Steam	3		1		4
Net tonnage	87		49		136
Motor	128	18	10	5	161
Net tonnage	1, 291	476	148	75	1, 990
Sail		3			3
Net tonnage		271			271
Total vessels	131	21	11	5	168
Total net tonnage	78	747	197	75	2, 397
Wholesale trade:					
Establishments	103	150	31	18	302
Persons engaged	427	2, 104	313	213	3, 057
Salaries and wages paid	$432, 493	$3, 574, 504	$291, 648	$340, 413	$4, 639, 058
Prepared products and by-products industries:					
Establishments	119	30	2	3	154
Persons engaged	3, 019	1, 080	68	279	4, 446
Salaries and wages paid	$1, 704, 135	$1, 571, 352	$50, 279	$331, 320	$3, 657, 086
Products	$10, 291, 561	$6, 014, 353	$348, 299	$280, 274	$16, 934, 487
Products prepared by the fishermen	$21, 030	$141, 124			$162, 154

[1] Includes two wholesale firms in Rockingham County, N. H.

SALTED AND SMOKED FISH INDUSTRIES

The salted and smoked fish industries of the New England States are conducted principally in Maine and Massachusetts.

In the salted fish industry in 1928 there were 50 plants, 16 of which were in Massachusetts, 33 in Maine, and 1 in Rhode Island. The total production of salted fish in New England during 1928 amounted to 23,561,768 pounds, valued at $2,367,015. This represents a decrease of 25 per cent in the production and 21 per cent in the value as compared with the production and its value for 1924 when the most recent comparable figures were obtained. The most important fish salted was cod, the production of which amounted to 11,755,900 pounds, valued at $1,572,507. Haddock was next in importance, the output of which amounted to 3,203,780 pounds, valued at $262,676.

Fish were smoked in 64 plants in New England during 1928, 44 of which were in Maine, 17 in Massachusetts, 2 in Rhode Island, and 1 in New Hampshire. The production of smoked fish in New England during 1928 amounted to 11,627,452 pounds, valued at $1,272,509, which is an increase of 12 per cent in quantity and 25 per cent in value as compared with the quantity and the value of the production in 1924. By far the most important smoked product of New England is herring which amounted to 7,470,283 pounds, valued at $689,041. Finnan haddie was next in importance accounting for 2,316,346 pounds, valued at $213,281.

Production of salted and smoked fish in New England, 1928

Products	Maine [1]		Massachusetts [2]		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Salted:						
Alewives	437,800	$14,514			437,800	$14,514
Cod	3,727,546	249,247	[2] 8,028,354	$1,323,260	11,755,900	1,572,507
Cusk	167,133	7,343	314,255	22,658	481,388	30,001
Haddock	322,668	15,809	2,881,112	246,867	3,203,780	262,676
Hake	1,560,502	64,523	959,045	60,180	2,519,547	124,703
Herring			363,200	18,760	363,200	18,760
Mackerel	62,500	5,700	1,529,000	127,215	1,591,500	132,915
Pollock	956,501	41,874	2,157,952	161,284	3,114,453	203,158
Miscellaneous [3]	28,500	1,187	65,700	6,594	94,200	7,781
Total	7,263,150	400,197	16,298,618	1,966,818	23,561,768	2,367,015
Smoked:						
Alewives	[4] 145,770	[4] 7,223			145,770	7,223
Finnan haddie	[1] 615,800	73,652	[2] 1,700,546	139,629	2,316,346	213,281
Halibut			20,656	6,281	20,656	6,281
Herring—						
Bloaters	1,000,799	51,357	2,870,412	247,133	3,871,211	298,490
Lengthwise	125,490	8,347			125,490	8,347
Medium scale	352,856	28,036	192,051	38,896	544,907	66,932
Boneless	2,797,200	292,807			2,797,200	292,807
Kippered			131,475	22,465	131,475	22,465
Salmon			197,272	92,463	197,272	92,463
Fillets—						
Cod and cusk			[5] 236,000	[5] 29,120	236,000	29,120
Haddock			[6] 634,147	[6] 109,493	634,147	109,493
Miscellaneous	6,000	900	600,978	124,707	606,978	125,607
Total	5,043,915	462,322	6,583,537	810,187	11,627,452	1,272,509

[1] Includes a small quantity of finnan haddie smoked in New Hampshire.
[2] A few cod salted and a small amount of finnan haddie smoked in Rhode Island have been included under Massachusetts.
[3] Includes pickled herring, cheeks, sounds, and tongues.
[4] Includes the production of 2 firms in Massachusetts.
[5] Includes the production of 1 firm in Maine.
[6] Includes the production of 2 firms in Maine.

MAINE

In 1928 Maine ranked second among the New England States in the importance of its fisheries, employing 34 per cent of the total number of fishermen and accounting for 20 per cent of the total catch. The fisheries and industries related to the fisheries, including the two wholesale establishments in New Hampshire, employed 9,305 persons. This is 22 per cent less than the number employed in these fisheries during 1924, which is the most recent year for which comparable data are available. Of the total number of persons, 5,596 were fishermen, 263 were employed on transporting vessels, 427 in the wholesale trade, and 3,019 in the prepared-products and by-products trade.

The total catch amounted to 123,326,155 pounds valued at $4,231,-091. This is an increase of 6 per cent in the catch and 2 per cent in the value of the catch as compared with the catch and its value for 1924. Of the total value of the catch, that for lobsters accounted for 48 per cent; cod, 10 per cent; herring, 9 per cent; haddock, 8 per cent; and soft clams, 5 per cent. Of the total production that of herring accounted for 52 per cent; cod, 13 per cent; haddock, 10 per cent; lobsters, 6 per cent; and soft clams, 3 per cent.

OPERATING UNITS BY GEAR

The catch of fishery products along the coast and in the coastal rivers of Maine during 1928 was taken by 5,596 fishermen who used 84 motor vessels, 5,624 motor and other small boats, and 20 major types of gear. The motor vessels had a combined capacity of 1,066 net tons.

The fisheries accounting for the greatest number of persons were the lobster-pot fishery, employing 2,756 fishermen and the hand-line fishery employing 1,162 fishermen.

CATCH BY GEAR

Five types of gear accounted for 67 per cent of the fish taken in the fisheries of Maine during 1928. Listed in order of their importance they were—lines which accounted for 26 per cent of the catch; haul seines, 18 per cent; purse seines, 11 per cent; and gill nets and pots, each, 6 per cent. The catch by lines consisted principally of haddock, cod, hake, cusk, and pollock; that by haul seines was almost entirely herring; that by purse seines principally herring and pollock; that by gill nets chiefly cod, pollock, and haddock; and that by pots principally lobsters.

OPERATING UNITS BY COUNTIES

Hancock County was foremost in the number of persons fishing, accounting for 23 per cent of the total; Washington County followed with 22 per cent. Other counties employing a considerable number of fishermen listed in the order of their importance in this respect were: Cumberland, Knox, and Lincoln. Cumberland County accounted for 40 per cent of the total number of fishing vessels and Knox County 27 per cent. Washington County led in the number of motor and other small fishing boats accounting for 26 per cent of the total. Hancock followed with 20 per cent.

CATCH BY COUNTIES

Fishing was prosecuted in the marine waters of 10 counties in Maine during 1928. Ranked according to value, the fisheries of Cumberland County were most important, accounting for 26 per cent of the total catch and 28 per cent of the total value of the catch. Knox County was next in value of the catch accounting for 13 per cent of the quantity and 20 per cent of the total value. Other important counties listed in order of their importance with respect to value of the catch were Hancock, Washington, and Lincoln.

Fisheries of Maine, 1928

OPERATING UNITS: BY GEAR

Items	Purse seines, market fish	Haul seines, common	Gill nets			Lines		Pound nets	Floating traps	Weirs
			Drift	Stake	Anchor	Trawl	Hand			
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:										
On vessels	130	53	10		62	221	41			
On boats and shore—										
Regular	119	352	25	1	188	878	587	2	61	397
Casual		20	2	4	29	2	534			67
Total	249	425	37	5	279	1, 104	1, 162	2	61	464
Vessels:										
Motor—										
5 to 10 tons	19	7			7	10	10			
11 to 20 tons	6	3	1		5	8	1			
21 to 30 tons	1					2				
31 to 40 tons						2				
41 to 50 tons		1				1				
51 to 60 tons						2				
Total vessels	26	11	1		12	25	11			
Total net tonnage	250	145	18		118	486	84			
Boats:										
Motor	41	105	12		96	698	368	1	22	166
Other	63	173	5	5	53	603	29	2	56	495
Apparatus:										
Number	62	146	248	13	1, 927	40, 906	4, 198	1	35	301
Length, yards	16, 651	29, 400								
Square yards			84, 432	1, 512	514, 760					
Hooks, baits, or snoods						2, 061, 218	5, 184			

Items	Fyke nets	Dip nets	Bag nets	Pocket nets	Otter trawls	Box traps	Pots		
							Crab	Eel	Lobster
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:									
On vessels					64				19
On boats and shore—									
Regular	23	1	32	7	56	3	4	14	2, 731
Casual	1	63	58			1		1	6
Total	24	64	90	7	120	4	4	15	2, 756
Vessels:									
Motor—									
5 to 10 tons					6				8
11 to 20 tons					6				
Total vessels					12				8
Total net tonnage					139				53
Boats:									
Motor	5	1			29			9	2, 380
Other	24	1	22		8		4	15	1, 530
Apparatus:									
Number	122	73	139	7	41	4	74	343	210, 832
Yards at mouth					833				

Fisheries of Maine, 1928—Continued

OPERATING UNITS: BY GEAR—Continued

Items	Harpoons, swordfish	Spears	Scallop dredges	Forks	Hoes	Grapple irons, kelp	By hand	Total exclusive of duplication
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:								
On vessels	165		17					478
On boats and shore—								
Regular	116	12	140	1, 014	249	1	6	4, 315
Casual		21	1	40	32			803
Total	281	33	158	1, 054	281	1	6	5, 596
Vessels:								
Motor—								
5 to 10 tons	2		4					53
11 to 20 tons	7		2					22
21 to 30 tons	2							3
31 to 40 tons	2							2
41 to 50 tons								2
51 to 60 tons	2							2
Total vessels	15		6					84
Total net tonnage	366		59					1, 066
Boats:								
Motor	69		93	87		1		2, 788
Other	10		1	657	98			2, 906
Apparatus:								
Number	79	33	107	1, 040	281	1		
Yards at mouth			167					

CATCH: BY GEAR

Species	Purse seines, market fish		Haul seines, common		Gill nets					
					Drift		Stake		Anchor	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	572, 400	$8, 604			4, 000	$200			39, 041	$904
Bonito									385	15
Butterfish	2, 131	357								
Cod									4, 613, 136	145, 837
Cusk									7, 753	167
Flounders									18, 960	622
Haddock									874, 009	19, 851
Hake									343, 905	5, 907
Halibut									435	56
Herring, sea	11, 493, 030	81, 549	21, 648, 870	$122, 098						
Mackerel	792, 580	36, 325			170, 358	7, 482				
Pollock	1, 070, 000	9, 835							992, 390	16, 936
Rosefish									20	
Salmon							1, 730	$692	887	337
Shad	83, 837	6, 766			248	33			239	19
Sharks									37, 147	472
Skates									75	11
Smelt	52, 530	10, 546	329, 426	57, 629					52, 350	12, 355
Sturgeon									555	73
Tomcod	2, 260	452	9, 944	299						
Tuna									688	38
Wolffish									2, 427	41
Total	14, 068, 768	154, 434	21, 988, 240	180, 026	174, 606	7, 715	1, 730	692	6, 984, 402	203, 641

Fisheries of Maine, 1928—Continued

CATCH: BY GEAR—Continued

Species	Lines				Pound nets		Floating traps	
	Trawl		Hand					
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives							600	$8
Bluefish							140	19
Bonito	400	$21						
Butterfish					1,200	$120	20,808	2,267
Cod	9,227,588	234,123	2,281,612	$53,378			125	4
Cusk	943,383	21,423	7,680	88				
Flounders	73,265	2,180	4,205	106			29,112	632
Grayfish	100,000	2,000						
Haddock	10,556,008	301,172	619,260	12,414				
Hake	7,162,541	98,614	127,889	1,585				
Halibut	159,785	26,057	31,071	4,706				
Herring, sea					700,000	4,000	169,814	914
Mackerel					15,000	300	609,978	27,372
Pollock	457,746	6,754	354,591	4,393				
Rosefish	1,390	26						
Salmon					100	30	1,590	394
Shad							25,425	884
Sharks	1,121	19					7,170	128
Smelt			240,750	60,762	12,000	2,400	460	92
Whiting							3,510	34
Wolffish	32,313	551	100	2				
Lobsters	300	120						
Squid							27,090	393
Total	28,715,900	693,060	3,667,158	137,434	728,300	6,850	895,822	33,141

Species	Weirs		Fyke nets		Dip nets		Bag nets		Pocket nets	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	647,250	$5,180			868,625	$4,105				
Butterfish	1,200	120								
Cunner					10,000	500				
Eels	20,000	1,600	2,050	$205						
Herring, sea	30,673,760	189,216								
Mackerel	7,900	442								
Salmon	10,440	3,835								
Shad	400	53								
Smelt	15,450	3,555			1,000	250	126,250	$28,100	2,000	$500
Suckers			62,560	6,256						
Tomcod							9,000	90		
Yellow perch			200	20						
Total	31,376,400	204,001	64,810	6,481	879,625	4,855	135,250	28,190	2,000	500

Species	Otter trawls		Box traps		Pots					
					Crab		Eel		Lobster	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod	64,278	$1,621								
Cusk	943	26								
Eels			15,000	$2,304			81,400	$6,310	11,200	$1,120
Flounders	1,049,771	58,003								
Haddock	154,707	3,688								
Hake	47,126	784								
Halibut	50	6								
Pollock	1,754	25								
Rosefish	1,010	21								
Sturgeon	97	14								
Wolffish	3,465	49								
Crabs, hard					25,000	$500			133,900	4,198
Lobsters	101	25							7,099,931	2,013,306
Scallops, sea	84	30								
Total	1,323,386	64,292	15,000	2,304	25,000	500	81,400	6,310	7,245,031	2,018,624

Species	Harpoons, swordfish		Spears		Scallop dredges		Forks	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Eels			12,000	$1,200				
Swordfish	693,071	$127,585						
Tuna	206,582	9,275						
Clams, soft, public							2,805,500	$148,345
Scallops, sea					326,094	$110,095		
Total	899,653	136,860	12,000	1,200	326,094	110,095	2,805,500	148,345

Fisheries of Maine, 1928—Continued

CATCH: BY GEAR—Continued

Species	Hoes		Grapple irons		By hand	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Clams, cockle					3,000	$180
Clams, soft, public	815,080	$80,411				
Periwinkles					2,000	500
Kelp			90,000	$450		
Total	815,080	80,411	90,000	450	5,000	680

OPERATING UNITS: BY COUNTIES

Items	Cumberland	Hancock	Kennebec	Knox	Lincoln	Penobscot	Sagadahoc	Waldo	Washington	York
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	271	22		78	70			4	26	7
On boats and shore—										
Regular	776	898	5	612	455	4	200	25	1,161	179
Casual		352		78	140	4	106	87	36	
Total	1,047	1,272	5	768	665	8	306	116	1,223	186
Vessels, motor:										
5 to 10 tons	17	4		18	10			1	2	1
11 to 20 tons	10	1		5	3				2	1
21 to 30 tons	2								1	
31 to 40 tons	2									
41 to 50 tons	1									
51 to 60 tons	2								1	
Total vessels	34	5		23	13			1	6	2
Total net tonnage	577	43		195	118			7	106	20
Boats:										
Motor	540	566	4	488	303	1	86	14	646	140
Other	452	585	5	420	306	6	117	60	841	114
Apparatus:										
Purse seines, market fish	22	12		8	15			1	2	2
Yards	5,150	2,317		2,150	4,624			1,000	750	660
Haul seines, common	85	9		20	15		5		8	4
Yards	19,160	810		2,040	2,780		780		3,030	800
Gill nets—										
Drift	66	150			4					28
Square yards	7,392	67,200			2,000					7,840
Stake		4				9				
Square yards		464				1,048				
Anchor	1,223	90		46	191	47		78	120	132
Square yards	352,836	29,520		11,932	68,450	2,510		6,060	9,132	34,320
Lines—										
Trawl	17,312	8,230		4,060	3,040		4,240	220	1,954	1,850
Hooks	810,700	418,518		221,000	152,000		212,000	11,000	144,000	89,000
Hand	36	1,821		422	1,072		562	50	227	8
Hooks	72	1,972		484	1,112		974	100	454	16
Pound nets	1									
Floating traps	26				3		6			
Weirs	1	89		33	6	2	6	34	130	
Fyke nets			36		30		56			
Dip nets	10	4		10	6		3	10	30	
Bag nets		21				4	2	61	51	
Pocket nets									7	
Otter trawls	23	7		7	1		1			2
Yards at mouth	595	35		118	30		15			40
Box traps		3			1					
Pots—										
Crab					74					
Eel	20	65		20			180	8	50	
Lobster	35,989	47,220		39,675	21,525		3,880		53,040	9,503
Harpoons, swordfish	46	1			3		17			12
Spears		20			12		1			
Dredges, scallop	14	53		25					15	
Yards at mouth	28	76		43					20	
Forks		342		109	160		12	3	414	
Hoes	215						40			26
Grapple iron, kelp				1						

Fisheries of Maine, 1928—Continued

CATCH: BY COUNTIES

Species	Cumberland		Hancock		Kennebec	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	8,041	$84	435,750	$3,285		
Bluefish	140	19				
Bonito	845	36				
Butterfish	19,643	1,972				
Cod	6,529,746	215,539	2,722,366	57,705		
Cunner	10,000	500				
Cusk	697,309	17,733	89,991	1,032		
Eels	6,400	640	34,400	3,494	2,000	$200
Flounders	644,243	23,499	109,850	8,820		
Haddock	6,056,380	202,741	2,092,690	36,126		
Hake	2,755,616	49,753	3,083,991	30,285		
Halibut	66,192	9,889	36,029	6,505		
Herring, sea	10,888,914	60,981	7,072,700	51,648		
Mackerel	552,934	27,513	53,620	2,145		
Pollock	1,205,668	20,301	831,228	8,259		
Rosefish	1,445	27				
Salmon	490	124	6,180	2,234		
Shad	25,664	903				
Sharks	45,338	618				
Smelt	295,681	53,780	139,800	36,722		
Sturgeon	517	67				
Suckers					20,000	2,000
Swordfish	632,685	115,965	60,386	11,620		
Tomcod	12,204	751				
Tuna	110,635	4,463				
Whiting	3,510	34				
Wolffish	26,870	515				
Crabs, hard	85,000	2,975	5,000	500		
Lobsters	1,223,727	305,737	1,575,000	442,520		
Clams, soft, public	523,000	52,300	920,900	46,845		
Squid	12,090	243				
Scallops. sea	11,478	5,729	86,994	30,495		
Total	32,452,405	1,175,431	19,356,875	780,240	22,000	2,200

Species	Knox		Lincoln		Penobscot	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	380,425	$4,508	714,600	$6,796		
Butterfish			3,696	517		
Cod	3,092,580	61,486	1,359,787	28,089		
Cusk	31,350	421	20,919	280		
Eels	1,000	100	7,600	760		
Flounders	271,980	22,027	58,905	3,447		
Grayfish	100,000	2,000				
Haddock	2,088,377	50,293	370,260	7,105		
Hake	825,286	9,507	326,624	4,640		
Halibut	23,062	3,458	8,550	1,280		
Herring, sea	5,596,760	36,708	7,197,780	57,360		
Mackerel	63,050	2,835	606,346	28,647		
Pollock	447,496	4,189	91,927	824		
Rosefish			975	20		
Salmon			1,200	300	1,870	$748
Shad	37,100	829	39,385	5,623		
Sharks	100	1				
Smelt	83,500	13,925	55,800	14,375	10,150	2,030
Sturgeon			57	10		
Suckers			20,000	2,000		
Tuna	303	15	25,000	875		
Wolffish	10,160	103				
Yellow perch			200	20		
Crabs, hard			42,500	1,025		
Lobsters	1,805,850	526,500	742,250	223,275		
Clams, soft, public	316,000	20,710	334,000	20,040		
Squid			15,000	150		
Scallops, sea	221,700	70,900	6	1		
Kelp	90,000	450				
Total	15,486,079	830,965	12,043,367	407,459	12,020	2,778

Fisheries of Maine, 1928—Continued

CATCH: BY COUNTIES—Continued

Species	Sagadahoc		Waldo		Washington		York	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	40,600	$258			365,000	$1,070	187,500	$3,000
Butterfish	500	75					1,500	300
Cod	822,754	22,050	65,000	$1,800	1,243,077	36,893	351,429	11,401
Cusk	91,018	1,811			22,522	250	6,650	177
Eels	77,050	6,205	1,000	120	1,000	100	11,200	1,120
Flounders	8,000	400					82,335	3,350
Haddock	586,820	16,704	15,000	600	632,362	13,207	362,095	10,349
Hake	542,225	10,690	300	12	111,265	1,339	36,154	664
Halibut	900	135			54,718	9,314	1,890	244
Herring, sea	1,005,500	7,615	3,118,050	21,125	29,805,770	162,340		
Mackerel	142,466	3,589			2,400	192	175,000	7,000
Pollock	30,120	572			249,626	3,365	20,416	433
Salmon			4,650	1,770	350	110	7	2
Shad							8,000	400
Skates							75	11
Smelt	71,635	15,527	101,900	21,250	63,750	17,080	10,000	1,500
Sturgeon							78	10
Suckers	22,560	2,256						
Tomcod			9,000	90				
Tuna	55,332	3,320					16,000	640
Wolffish							1,275	25
Crabs, hard					26,400	198		
Lobsters	188,098	57,240			1,254,832	378,985	310,575	79,194
Clams, cockle					3,000	180		
Clams, soft, public	205,080	17,811	3,000	300	1,191,600	58,050	127,000	12,700
Scallops, sea					6,000	3,000		
Periwinkles					2,000	500		
Total	3,890,658	166,258	3,317,900	47,067	35,035,672	686,173	1,709,179	132,520

INDUSTRIES RELATED TO THE FISHERIES

Transporting trade.—In 1928 there were 263 persons in Maine engaged primarily in transporting the catch of fish. In this trade 3 steam vessels and 128 motor vessels having a total capacity of 1,378 net tons were operated. The size of vessel in most popular use ranged from 5 to 10 net tons.

Wholesale trade.—There were 103 wholesale establishments in Maine engaged chiefly in handling fresh and frozen products. This number includes 2 in New Hampshire. This is 34 per cent of the total number of such establishments in the New England section. These establishments employed 427 persons who received $432,493 in salaries and wages. Knox County accounted for 27 of these establishments; Hancock County, 24; Washington County, 22; and Cumberland County, 17.

Prepared and by-products trade.—There were 119 establishments in Maine during 1928 engaged primarily in the manufacture of prepared fishery products or by-products. This is 78 per cent of the total number in the New England section. They employed 3,019 persons who received $1,704,135 in salaries and wages. The products manufactured consisting principally of canned sardines and clam products were valued at $10,291,561. Detailed statistics of most of the items manufactured may be obtained from "Fishery Industries of the United States, 1928." Bureau of Fisheries Document No. 1067.

In addition to the above, 614,054 pounds of fresh salted and smoked products valued at $21,030 were prepared by the fishermen.

Industries related to the fisheries of Maine, 1928

TRANSPORTING

Items	Number	Items	Number
Men on transporting vessels	263	Transporting vessels—Continued.	
Transporting vessels:		Motor—Continued.	
Steam—		21 to 30 tons	4
20 to 30 tons	2	31 to 40 tons	1
41 to 50 tons	1	Total	128
Total	3	Net tonnage	1,291
Net tonnage	87	Total vessels	131
Motor—		Total net tonnage	1,378
5 to 10 tons	79		
11 to 20 tons	44		

WHOLESALE FISHERY TRADE [1]

Items	Cumberland County	Hancock County	Knox County	Lincoln County	Penobscot, Sagadahoc, and York Counties [1]	Washington County	Total
Establishments	17	24	27	7	6	22	103
Persons engaged:							
Proprietors	24	26	30	10	7	23	120
Salaried employees	22	3	16	2	1	9	53
Wage earners	141	40	34	10	5	24	254
Paid to salaried employees	$57,598	$12,900	$63,360	$10,705	$1,000	$11,252	$156,815
Paid to wage earners	176,145	30,100	38,099	10,954	6,000	14,380	275,678
Total salaries and wages	233,743	43,000	101,459	21,659	7,000	25,632	432,493

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS [2]

Items	Number
Establishments	119
Persons engaged:	
Proprietors	147
Salaried employees	96
Wage earners	2,776
Paid to salaried employees	$257,909
Paid to wage earners	1,446,226
Total salaries and wages	1,704,135

Products [3]	Quantity	Value
Salted pounds	7,263,150	$400,197
Smoked do	5,071,264	472,308
Canned:		
Sardines standard cases [4]	2,055,763	8,076,546
Clam products do	164,856	599,671
Miscellaneous fishery products standard cases [4]	60,176	353,988
By-products:		
Scrap, meal, etc. tons	6,383	173,903
Herring oil gallons	166,055	57,974
Cod liver oil, crude do	47,232	36,667
Other products [5]		120,307
Total		10,291,561

PRODUCTS PREPARED BY THE FISHERMEN

Items	Pounds	Value	Items	Pounds	Value
Fresh:			Salted—Continued.		
Livers	240,475	$4,804	Cusk	685	$13
Sounds	500	15	Hake	585	10
Spawn	31,737	1,506	Mackerel	387	31
Tongues	1,730	35	Pollock	45	1
Salted:			Smoked: Alewives	175,200	9,290
Alewives	125,800	3,452			
Cod	36,910	1,873	Total	614,054	21,030

[1] Includes 2 firms in Rockingham County, N. H.
[2] Includes a small quantity of fish smoked in New Hampshire.
[3] Includes the production of 21 firms whose activities were principally in the wholesale fishery trade.
[4] A standard case contains one hundred ¼-pound cans of sardines, 48 No. 1 cans of clam products or forty-eight 1-pound cans of miscellaneous canned fishery products.
[5] Includes herring skins and scales, tanners oil, and kelp products.

NEW HAMPSHIRE

The fisheries of New Hampshire in 1928 employed less than one-half of 1 per cent of the total number of fishermen and accounted for less than one-half of 1 per cent of the total catch of the New England section. Only two wholesale plants were operated in this State, therefore, the number of persons engaged, salaries and wages, and products of these establishments are included under Maine. No transporting vessels were operated. There were 53 persons engaged in fishing.

The total catch amounted to 239,099 pounds, valued at $45,535. This is a decrease of 47 per cent in the catch and 19 per cent in the value of the catch as compared with the catch and its value for 1924, which is the most recent year for which comparable data are available. Of the catch, lobsters accounted for 54 per cent of the quantity and 90 per cent of the value. The fisheries of New Hampshire were confined to Rockingham County.

OPERATING UNITS BY GEAR

The catch of fishery products in the marine waters of New Hampshire during 1928 was taken by 53 fishermen, 76 motor and other small fishing boats, and 2 major types of gear.

In the lobster pot fishery 36 fishermen were employed.

CATCH BY GEAR

The entire catch during 1928 in the marine waters of New Hampshire was taken by lobster pots and lines. Lobster pots accounted for 54 per cent and lines, the remaining 45 per cent. The catch by lobster pots was exclusively lobsters and that by lines principally haddock and cod.

Fisheries of New Hampshire, 1928

OPERATING UNITS: BY GEAR

Items	Lines		Lobster pots	Total, exclusive of duplication
	Trawl	Hand		
Fishermen:				
On boats and shore—	*Number*	*Number*	*Number*	*Number*
Regular	5		36	41
Casual		12		12
Total	5	12	36	53
Boats:				
Motor	2		36	38
Other	2		36	38
Apparatus:				
Number	100	48	2,380	
Hooks, baits, or snoods	5,000	192		

CATCH: BY GEAR

Species	Trawl lines		Hand lines		Lobster pots	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod	25,000	$750				
Cusk	10,000	200				
Flounders	4,000	200				
Haddock	50,000	2,000				
Hake	10,000	200				
Pollock	5,000	150				
Smelt			5,000	$1,250		
Lobsters					130,099	$40,785
Total	104,000	3,500	5,000	1,250	130,099	40,785

MASSACHUSETTS

The fisheries of Massachusetts ranked first among the New England States during 1928, accounting for 46 per cent of the total number of fishermen and 63 per cent of the total catch. The fisheries and industries related to the fisheries employed 11,013 persons, which is 19 per cent greater than the number employed during 1924, the most recent year for which comparable data are available. Of the total 7,751 were fishermen, 78 were employed on transporting vessels, 2,104 in the wholesale trade, and 1,080 in the prepared products and by-products industries.

The total catch amounted to 380,168,359 pounds, valued at $15,648,776. This is an increase of 56 per cent in the catch and 45 per cent in the value of the catch as compared with the catch and its value for 1924. Of the total value of the catch, that for haddock accounted for 33 per cent; cod, 14 per cent; mackerel, 12 per cent; and flounders, 10 per cent. Of the total production, that of haddock accounted for 47 per cent; cod, 18 per cent; and mackerel and flounders, each 10 per cent.

OPERATING UNITS BY GEAR

The catch of fishery products in the marine waters of Massachusetts during 1928 was taken by 7,751 fishermen, who used 22 steam vessels, 397 motor vessels, 1 sailing vessel, 3,816 motor and other small fishing boats, and 17 major types of gear. The vessels had a combined capacity of 16,332 net tons.

The fisheries accounting for the greatest number of persons were the otter trawl fishery, employing 2,507 fishermen, and the trawl line fishery, employing 1,742 fishermen.

CATCH BY GEAR

Three types of gear accounted for 86 per cent of the fish taken in the marine fisheries of Massachusetts during 1928. Listed in order of their importance they were otter trawls, which accounted for 52 per cent of the catch; lines, 26 per cent; and purse seines, 8 per cent. The catch by otter trawls consisted largely of haddock, flounders, and cod; that by lines principally haddock, cod, hake, and halibut; and that by purse seines mostly mackerel.

OPERATING UNITS BY COUNTIES

Suffolk County was foremost in the number of persons fishing, accounting for 31 per cent of the total. Essex County followed with 28 per cent. Other counties employing a considerable number of fishermen, listed in order of their importance, were Barnstable, Plymouth, Bristol, and Nantucket. Suffolk County accounted for 40 per cent of the total number of fishing vessels and Essex 33 per cent. Barnstable County led in the number of motor and other small fishing boats, accounting for 33 per cent of the total. Plymouth followed with 21 per cent.

CATCH BY COUNTIES

Fishing was prosecuted in the marine waters of eight counties in Massachusetts during 1928. Ranked according to value the fisheries of Suffolk were most important, accounting for 53 per cent of the total catch and 42 per cent of the total value of the catch. Essex County was next in the value of the catch, accounting for 28 per cent of quantity and 29 per cent of the total value. Other important counties listed in order of their importance with respect to the value of the catch were Barnstable, Bristol, and Dukes.

Fisheries of Massachusetts, 1928

OPERATING UNITS: BY GEAR

Items	Purse seines, market fish	Haul seines, common	Gill nets		Lines		Pound nets	Floating traps
			Drift	Anchor	Trawl	Hand		
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:								
On vessels	1,013		450	133	1,328	362		
On boats and shore—								
Regular	81	15	178	10	403	131	187	41
Casual	3	34	9	3	11	27		4
Total	1,097	49	637	146	1,742	520	187	45
Vessels:								
Motor—								
5 to 10 tons	7		16	4	7	4		
11 to 20 tons	33		33	8	4	6		
21 to 30 tons	11		6	5	2	1		
31 to 40 tons	9		4		3			
41 to 50 tons	12		3		3	3		
51 to 60 tons	10		1		11	8		
61 to 70 tons	8				20	1		
71 to 80 tons	2				9	1		
81 to 90 tons					2	2		
91 to 100 tons	1				3	1		
101 to 110 tons	1				1			
111 to 120 tons					2			
121 to 130 tons					2			
131 to 140 tons					1			
Total	94		63	17	70	27		
Net tonnage	3,140		1,078	290	4,178	1,109		
Sail			1		1			
Net tonnage			152		152			
Total vessels	94		64		71	27		
Total net tonnage	3,140		1,230		4,330	1,109		
Boats:								
Motor	11	8	69	11	175	86	71	16
Other	2	11	45	9	102	86	115	16
Apparatus:								
Number	106	10	7,677	902	49,932	731	121	25
Length, yards	52,715	520						
Square yards			2,059,774	252,160				
Hooks, baits, or snoods					2,453,480	1,646		

Fisheries of Massachusetts, 1928—Continued

OPERATING UNITS: BY GEAR—Continued

Items	Fyke nets	Dip nets	Otter trawls	Pots				Harpoons, swordfish
				Crab	Eel	Lobster	Periwinkle and cockle	
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels			2,113			14		1,190
On boats and shore—								
Regular	15	50	393	37	52	725	4	3
Casual	8	10		2	25	1		
Total	23	60	2,506	39	77	740	4	1,193
Vessels:								
Steam—								
91 to 100 tons			4					
111 to 120 tons			5					
121 to 130 tons			1					
131 to 140 tons			1					
151 to 160 tons			2					
161 to 170 tons			1					
171 to 180 tons			2					1
181 to 190 tons			1					
201 to 210 tons			1					
211 to 220 tons			2					
241 to 250 tons			1					
261 to 270 tons			1					
Total			22					1
Net tonnage			3,405					180
Motor—								
5 to 10 tons			39			6		7
11 to 20 tons			103			2		45
21 to 30 tons			20					7
31 to 40 tons			13					4
41 to 50 tons			10					5
51 to 60 tons			20					17
61 to 70 tons			6					12
71 to 80 tons			4					4
81 to 90 tons								1
91 to 100 tons			3					1
101 to 110 tons			5					
111 to 120 tons			4					
121 to 130 tons			1					
131 to 140 tons								1
Total			228			8		104
Net tonnage			6,439			64		3,641
Total vessels			250			8		105
Total net tonnage			9,844			64		3,821
Boats:								
Motor	15	32	131	36	42	567		3
Other	15	18	82	8	50	522		3
Apparatus:								
Number	92	45	379	2,315	1,678	61,687	400	108
Yards at mouth			10,288					

Fisheries of Massachusetts, 1928—Continued

OPERATING UNITS: BY GEAR

Items	Spears	Dredges			Tongs	Rakes	Forks	Hoes	Total, exclusive of duplication
		Oyster	Scallop	Clam					
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels		14	33	41		2			4,152
On boats and shore—									
Regular	65	48	848	115	125	490	22	481	3,275
Casual	19	1	120	73				1	324
Total	84	63	1,001	229	125	492	22	482	7,751
Vessels:									
Steam—									
91 to 100 tons									4
111 to 120 tons									5
121 to 130 tons									1
131 to 140 tons									1
151 to 160 tons									2
161 to 170 tons									1
171 to 180 tons									2
181 to 190 tons									1
201 to 210 tons									1
211 to 220 tons									2
241 to 250 tons									1
261 to 270 tons									1
Total									22
Net tonnage									3,405
Motor—									
5 to 10 tons		5	10	10		1			78
11 to 20 tons		1	2	6					139
21 to 30 tons									34
31 to 40 tons									20
41 to 50 tons									23
51 to 60 tons									37
61 to 70 tons									27
71 to 80 tons									13
81 to 90 tons									3
91 to 100 tons									8
101 to 110 tons									6
111 to 120 tons									6
121 to 130 tons									2
131 to 140 tons									1
Total		6	12	16		1			397
Net tonnage		58	98	150		5			12,775
Sail									1
Net tonnage									152
Total vessels		6	12	16		1			420
Total net tonnage		58	98	150		5			16,332
Boats:									
Motor	4	27	542	64	33	243	2	86	1,957
Other	23	21	346	17	99	261	3	154	1,859
Apparatus:									
Number	86	56	3,230	211	125	498	22	482	
Yards at mouth		68	3,521	220					

Fisheries of Massachusetts, 1928—Continued

CATCH: By gear

Species	Purse seines, market fish		Haul seines, common		Gill nets			
					Drift		Anchor	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	345,900	$4,550	1,607,560	$21,756	2,300	$87		
Bluefish					3,215	684		
Bonito	730	29			1,100	29		
Butterfish	67,425	9,594			2,370	220	110	$22
Cod					258,281	14,253	4,394,941	229,580
Cusk					126	3	3,017	67
Flounders							1,274	13
Haddock					84,551	1,469	1,519,485	31,889
Hake			45,000	900	1,737	37	67,613	1,250
Halibut					22	4	482	94
Herring, sea	451,200	4,797			765,026	7,750		
Mackerel	28,938,651	1,478,416	18,000	900	5,610,612	292,400	2,204	176
Pollock	133,290	5,835			198,736	3,822	3,296,318	62,411
Sand launce	139,575	1,596						
Shad	5,189	254						
Sharks	660	25			4,148	111	14,926	229
Skates							375	6
Tautog							300	21
White perch			10,400	1,560				
Whiting	5,261	89						
Wolffish	7,600	76					4,411	107
Total	30,095,481	1,505,261	1,680,960	25,116	6,932,224	320,869	9,305,456	325,865

Species	Lines				Pound nets		Floating traps		Fyke nets	
	Trawl		Hand							
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives					17,347	$176	68,225	$738		
Bluefish			1,100	$170	5,396	589	4,805	256		
Bonito					16,565	1,891	36	5		
Butterfish					401,384	54,019	40,750	6,138		
Cod	40,555,298	$1,269,921	8,837,372	294,065	44,940	1,956	18,370	585		
Cusk	2,077,493	49,130	40,625	919						
Eels			6,598	990	11,588	1,686			40,554	$5,587
Flounders	244,053	11,062	44,294	3,229	23,794	1,377	450	22	5,000	300
Grayfish					68,210	818				
Haddock	32,707,417	1,060,608	777,411	23,124	680	27				
Hake	6,209,743	135,442	178,497	3,625						
Halibut	3,584,565	538,868	64,336	10,670						
Herring, sea					2,089,000	25,548	523,983	6,437		
Hickory shad					25	2				
King whiting					98	14				
Mackerel			3,608	329	2,090,560	67,626	294,069	11,002		
Menhaden					4,356	48				
Pollock	1,351,779	25,569	810,804	16,222	21,087	642	10,600	167		
Rosefish	1,250	18								
Salmon	10,134	407			10	2	52	13		
Sand launce					173,105	1,731				
Scup			784,140	31,665	71,066	2,994				
Sea bass			150,500	15,040	3,781	509				
Shad					24,732	1,934	960	132		
Sharks	7,065	182	50	1	9,249	237				
Skates	5,000	75			5,540	133				
Skipper or "billfish"					11,938	826	912	128		
Smelt			31,896	4,389	460	34				
Squeteagues					3,426	498				
Striped bass			2,009	801	6,348	710				
Sturgeon					430	68	260	52		
Tautog	25,000	2,500	100,949	8,160	25,682	2,299				
Tomcod					585	29				
Tuna or horse mackerel					30,487	3,060	3,660	306		
Whiting			30,000	900	5,145,737	51,465	1,526,166	13,761		
Wolffish	89,332	2,435	26,032	732						
Yellow perch					50	5				
Squid					5,164,495	110,246	375,929	7,276		
Total	86.868,129	3,096,217	11,890,221	415,031	15,472,151	333,199	2,869,227	47,018	45,554	5,887

Fisheries of Massachusetts, 1928—Continued

CATCH: BY GEAR—Continued

Species	Dip nets		Otter trawls		Pots, crab	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	191,640	$1,916	15,000	$75		
Bonito			34	1		
Butterfish			68,358	10,004		
Cod			13,556,487	458,015		
Cunner			30	2		
Cusk			64,001	1,450		
Flounders			36,367,062	1,624,671		
Haddock			142,488,231	4,113,844		
Hake			2,818,482	63,415		
Halibut			411,308	56,514		
Herring, sea	1,814,929	27,945	1,400	32		
Mackerel			203,387	12,090		
Pollock			1,878,112	54,115		
Rosefish			122,138	1,865		
Salmon			5,854	288		
Scup			66	1		
Sea robin			350	3		
Shad			30	2		
Sharks			4,569	123		
Skates			22,003	406		
Sturgeon			2,148	447		
Whiting			288,666	4,752		
Wolffish			393,438	10,000		
Crabs, hard					3,079,619	$70,484
Shrimp	1,200	900				
Scallops, sea			3,318	185		
Total	2,007,769	30,761	198,714,472	6,412,300	3,079,619	70,484

Species	Pots						Harpoons, swordfish	
	Eel		Lobster		Periwinkle and cockle			
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Eels	216,418	$23,713						
Sharks							41,251	$6,997
Swordfish							2,730,085	481,016
Tuna or horse mackerel							1,495	79
Crabs, hard			59,500	$1,083				
Lobsters			2,042,331	761,561				
Clams, cockle					5,370	$2,317		
Total	216,418	23,713	2,101,831	762,644	5,370	2,317	2,772,831	488,092

Species	Spears		Dredges			
			Oyster		Scallop	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Eels	80,991	$10,329				
Oysters, market, private			578,823	$277,450		
Oysters, seed, private			278,544	40,139		
Scallops, bay					1,206,306	$536,550
Scallops, sea					115,806	42,395
Total	80,991	10,329	857,367	317,589	1,322,112	578,945

Species	Dredges, clam		Tongs	
	Pounds	*Value*	*Pounds*	*Value*
Clams, hard, public	533,952	$141,914	239,488	$91,731
Clams, soft, public			1,370	223
Oysters, market, private			147,126	76,654
Oysters, seed, private			17,080	1,586
Total	533,952	141,914	405,064	170,194

Fisheries of Massachusetts, 1928—Continued

CATCH: BY GEAR—Continued

Species	Rakes		Forks		Hoes	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Clams, cockle					1,500	$600
Clams, hard, public	857,536	$279,939			30,440	11,415
Clams, soft, public	32,860	5,735			1,762,860	227,279
Clams, razor					38,400	8,000
Oysters, market, private	4,081	1,749	23,919	$9,651		
Oysters, seed, private	16,226	1,507	12,880	1,196		
Periwinkles	10,250	1,600				
Scallops, bay	28,998	11,798				
Irish moss	91,210	4,562				
Total	1,041,161	306,890	36,799	10,847	1,833,200	247,294

OPERATING UNITS: BY COUNTIES

Items	Barnstable	Bristol	Dukes	Essex	Nantucket	Norfolk	Plymouth	Suffolk
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	113	246	47	1,675	95		4	1,972
On boats and shore—								
Regular	942	354	216	444	198	47	664	410
Casual	21	7	58	49	158		31	
Total	1,076	607	321	2,168	451	47	699	2,382
Vessels:								
Steam—								
91 to 100 tons								4
111 to 120 tons								5
121 to 130 tons								1
131 to 140 tons								1
151 to 160 tons								2
161 to 170 tons								1
171 to 180 tons								2
181 to 190 tons				1				
201 to 210 tons								1
211 to 220 tons								2
241 to 250 tons								1
261 to 270 tons								1
Total				1				21
Net tonnage				184				3,221
Motor—								
5 to 10 tons	14	12	7	19	9		2	15
11 to 20 tons	12	19	3	32	16			57
21 to 30 tons		8	1	13	1			11
31 to 40 tons		4		6				10
41 to 50 tons		2	1	13				7
51 to 60 tons		1		19				17
61 to 70 tons	1			16				10
71 to 80 tons				11				2
81 to 90 tons				3				
91 to 100 tons				4				4
101 to 110 tons				2				4
111 to 120 tons								6
121 to 130 tons								2
131 to 140 tons								1
Total	27	46	12	138	26		2	146
Net tonnage	344	870	171	5,557	304		20	5,509
Sail				1				
Net tonnage				152				
Total vessels	27	46	12	140	26		2	167
Total net tonnage	344	870	171	5,893	304		20	8,730
Boats:								
Motor	555	210	203	259	144	41	410	135
Other	715	238	209	240	17	48	392	

Fisheries of Massachusetts, 1928—Continued

OPERATING UNITS: BY COUNTIES—Continued

Items	Barnstable	Bristol	Dukes	Essex	Nantucket	Norfolk	Plymouth	Suffolk
Apparatus:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Purse seines, market fish	8	1	1	51				45
Yards	3,200	120	120	27,060				22,215
Haul seines, common	1		2	6			1	
Yards	20		240	240			20	
Gill nets—								
Drift	885	160	479	3,655			10	2,488
Square yards	171,200	33,800	135,120	1,029,714			1,800	688,140
Anchor	20			834				48
Square yards	3,600			235,024				13,536
Lines—								
Trawl	3,260		240	22,292	80		160	23,900
Hooks	163,000		12,000	1,049,680	4,000		41,000	1,183,800
Hand	72	78	24	373		10	20	154
Hooks	252	156	48	822		20	40	308
Pound nets	94	9	11	2	4		1	
Floating traps	6			19				
Fyke nets	78	2	12					
Dip nets	7			13		2	8	15
Otter trawls	66	34	15	53	22			189
Yards at mouth	1,683	986	384	1,430	645			5,160
Pots—								
Crab				990		30	215	1,080
Eel	788	175	285	175	155		100	
Lobster	8,524	10,895	11,700	14,052	900	2,567	11,849	1,200
Periwinkle and cockle	400							
Harpoons, swordfish	2	6	11	52	7			30
Spears	42	29		3			12	
Dredges—								
Oyster	28	6					22	
Yards at mouth	31	7					30	
Scallop	558	442	508		692		1,030	
Yards at mouth	928	590	22		608		1,373	
Clam	30	72	11		98			
Yards at mouth	27	67	2		124			
Tongs	41	56					28	
Rakes	297	15	86		50	4	46	
Forks	4						18	
Hoes	107	15		182			178	

CATCH: BY COUNTIES

Species	Barnstable		Bristol		Dukes		Essex	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	360,000	$3,280	2,667	$29	627,240	$6,273	523,265	$6,029
Bluefish	7,053	1,115	917	56	1,121	244	4,825	260
Bonito	6,497	682	12	2	3,092	372	1,830	58
Butterfish	305,169	40,662	9,982	1,421	85,892	10,308	94,954	14,098
Cod	2,597,463	105,394	1,403,536	52,400	124,578	3,858	30,385,823	1,042,668
Cusk	30,929	789	7,040	128	3,600	68	858,879	18,664
Eels	187,221	21,903	44,130	6,619	65,450	6,667	16,998	2,000
Flounders	8,060,845	343,169	6,038,636	312,425	1,327,985	53,522	2,055,927	114,170
Grayfish	3,360	168	3,348	35	53,502	535		
Haddock	3,833,732	125,001	10,556,956	299,780	453,146	14,426	37,601,048	1,149,607
Hake	590,353	12,457	94,772	1,680	12,766	262	2,314,314	48,732
Halibut	31,929	4,636	202,179	21,275	75	54	2,867,195	423,136
Herring, sea	1,952,970	23,622	31,688	1,604	1,560	16	2,239,908	23,720
Hickory shad					25	2		
King whiting	11	3	50	5	37	6		
Mackerel	4,173,905	148,691	153,736	9,175	765,509	34,257	18,607,318	977,528
Menhaden			243	7	4,113	41		
Pollock	232,631	6,011	17,843	435	12,156	365	4,756,207	91,829
Rosefish	3,259	46	438	5			20,220	243
Salmon	85	4					4,772	197
Sand launce	312,680	3,327						
Scup	755,104	30,352	31,009	1,557	69,089	2,749		
Sea bass	150,140	15,014			2,741	255		
Shad	24,368	1,904	33	4	16	2	5,190	328
Sharks	1,970	104	4,079	41	200	2	60,095	7,368
Skates	2,475	124	3,205	104	2,335	29	4,070	62
Skipper or "billfish"	12,850	954						
Smelt	150	3	310	31			7,496	1,949
Squeteagues	123	13	2,481	361	822	124		
Striped bass	8,060	1,482	259	24	38	5		

Fisheries of Massachusetts, 1928—Continued

CATCH: BY COUNTIES—Continued

Species	Barnstable		Bristol		Dukes		Essex	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Sturgeon	50	$8					807	$161
Swordfish	15,058	2,710	261,218	$43,237	398,188	$66,513	1,299,214	232,888
Tautog	27,054	2,144	96,962	8,184	2,615	131	300	21
Tomcod			585	29				
Tuna or horse mackerel	32,647	3,276					2,995	169
White perch					10,400	1,560		
Whiting	5,760,073	57,601	4,220	49	75,170	753	832,943	6,846
Wolffish	46,501	956	486	10	500	10	92,058	2,147
Yellow perch			50	5				
Crabs, hard							130,500	3,213
Lobsters	165,264	72,763	270,652	98,647	550,743	178,080	578,069	214,014
Shrimp	1,200	900						
Squid	5,160,021	108,537	121,933	4,208	100,125	1,001	76,145	1,280
Clams, cockle	5,370	2,317						
Clams, hard, public	517,104	179,909	333,824	126,902	240,000	85,300		
Clams, razor	38,400	8,000						
Clams, soft, public	215,870	43,081	1,000	250	4,800	960	1,136,230	113,623
Oysters, market, private	707,686	345,677	2,100	900				
Oysters, seed, private	139,503	27,018	14,700	1,575				
Periwinkles			250	100				
Scallops, bay	278,322	132,389	53,184	21,183	231,396	123,218		
Scallops, sea	28,014	13,005	87,060	29,020			3,030	159
Total	36,783,470	1,891,201	19,857,773	1,043,502	5,231,025	591,968	106,572,625	4,497,167

Species	Nantucket		Norfolk		Plymouth		Suffolk	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives			32,000	$320	601,500	$12,075	101,300	$1,292
Bluefish	600	$24						
Bonito	7,000	840					34	1
Butterfish	16,950	3,390			510	77	66,940	10,041
Cod	464,915	14,672			12,200	732	32,687,174	1,048,651
Cunner							30	2
Cusk							1,284,814	31,920
Eels	20,600	1,854			21,750	3,262		
Flounders	4,693,467	168,762					14,509,067	648,626
Grayfish	8,000	80						
Haddock	1,254,379	33,531			16,510	826	123,862,004	3,607,790
Hake	1,268	31					6,307,599	141,507
Halibut	433	68					958,902	156,981
Herring, sea					466,812	4,918	952,600	18,629
Mackerel	21,450	572			45,760	3,738	13,393,413	688,978
Pollock	1,645	36					2,680,244	70,107
Rosefish							99,471	1,589
Salmon							11,193	509
Scup	4	1					66	1
Sea bass	1,400	280						
Sea robin							350	3
Shad	1,000	60					304	24
Sharks	3,000	90					12,574	300
Skates							20,833	301
Smelt			14,720	1,472	9,680	968		
Sturgeon	380	60					1,601	338
Swordfish	121,935	20,873					634,472	114,795
Tautog					25,000	2,500		
Whiting					1,540	15	321,884	5,703
Wolffish	330	6					380,937	10,221
Crabs, hard			14,809	740	43,810	489	2,950,000	67,125
Lobsters	38,250	15,300	78,008	35,330	326,045	135,072	35,300	12,355
Squid	53,800	1,076			28,400	1,420		
Clams, cockle					1,500	600		
Clams, hard, public	509,888	110,163			60,600	22,725		
Clams, soft, public					439,190	75,323		
Oyster, market, private					44,163	18,927		
Oysters, seed, private					170,527	15,835		
Periwinkles					10,000	1,500		
Scallops, bay	123,852	65,858			548,550	205,700		
Scallops, sea	774	385					246	11
Irish moss			17,160	859	74,050	3,703		
Total	7,345,320	438,012	156,697	38,721	2,948,097	510,405	201,273,352	6,637,800

INDUSTRIES RELATED TO THE FISHERIES

Transporting trade.—In 1928 there were 78 persons in Massachusetts engaged primarily in transporting the catch of fish. In this trade 18 motor vessels and 3 sailing vessels having a total capacity of 747 net tons were operated. The size of vessel in most popular use ranged from 5 to 20 net tons.

Wholesale trade.—There were 150 wholesale establishments along the coast of Massachusetts engaged chiefly in handling fresh and frozen products. This is 50 per cent of the total number of such establishments in New England. These establishments employed 2,104 persons who received $3,574,504 in salaries and wages. Suffolk County had 96 wholesale establishments. Other counties of importance were Barnstable, Essex, and Bristol.

Prepared and by-products trade.—There were 30 establishments along the coast of Massachusetts in 1928 engaged primarily in the prepared fishery products or by-products trade. This is 19 per cent of the total number of such establishments in the New England section. These establishments employed 1,080 persons who received $1,571,352 in salaries and wages. The products manufactured, consisting principally of salted fish and miscellaneous canned fishery products, were valued at $6,014,353. Detailed statistics of most of the items manufactured may be obtained from "Fishery Industries of the United States, 1928," Bureau of Fisheries Document No. 1067.

In addition to the above, 3,430,275 pounds of fresh and salted fishery products valued at $141,124 were prepared by the fishermen.

Industries related to the fisheries of Massachusetts, 1928

TRANSPORTING

Items	Number	Items	Number
Men on transporting vessels	78	Transporting vessels—Continued.	
Transporting vessels:		Sail—	
Motor—		81 to 90 tons	1
5 to 10 tons	6	91 to 100 tons	2
11 to 20 tons	6	Total	3
21 to 30 tons	2	Net tonnage	271
41 to 50 tons	1	Total vessels	21
71 to 80 tons	1	Total net tonnage	747
81 to 90 tons	2		
Total	18		
Net tonnage	476		

WHOLESALE FISHERY TRADE

Items	Barnstable County	Bristol County	Dukes, Nantucket, and Plymouth Counties	Essex County	Suffolk County	Total
Establishments	22	8	6	18	96	150
Persons engaged:						
Proprietors	19	8	8	31	170	236
Salaried employees	32	9	6	34	305	386
Wage earners	192	43	17	167	1,063	1,482
Paid to salaried employees	$66,954	$24,805	$11,140	$99,671	$1,368,470	$1,571,040
Paid to wage earners	252,584	63,620	22,620	170,884	1,493,756	2,003,464
Total salaries and wages	319,538	88,425	33,760	270,555	2,862,226	3,574,504

Industries related to the fisheries of Massachusetts, 1928—Continued

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS

Items	Number	Products [1]	Quantity	Value
Establishments	30	Salted ... pounds	16,294,618	$1,966,418
Persons engaged:		Smoked ... do	6,462,188	790,801
Proprietors	41	Canned:		
Salaried employees	115	Mackerel ... standard cases [2]	10,382	92,425
Wage earners	924	Miscellaneous fishery products		1,359,606
		Scrap, meal, etc ... tons	6,943	445,732
Paid to salaried employees	$356,819	Cod liver oil, crude ... gallons	171,911	134,550
Paid to wage earners	1,214,533	Other products [3]		1,224,821
Total salaries and wages	1,571,352	Total		6,014,353

PRODUCTS PREPARED BY THE FISHERMEN

Items	Pounds	Value	Items	Pounds	Value
Fresh:			Salted—Continued		
Livers	450,000	$11,000	Halibut	3,630	$316
Spawn	256,807	15,176	Herring	615,600	22,950
Salted:			Mackerel	65,430	3,861
Alewives	560,000	14,000	Pollock	8,616	173
Cod	1,443,919	72,744	Sturgeon caviar	168	168
Cusk	6,405	136			
Haddock	7,980	414	Total	3,430,275	141,124
Hake	11,720	186			

[1] Includes salted and smoked fish prepared by eight firms whose activities were principally in the wholesale fishery trade.
[2] A standard case contains forty-eight 1-pound cans of mackerel.
[3] Includes liquid glue, herring scales, isinglass and blackfish oil.

RHODE ISLAND

The fisheries of Rhode Island in 1928 employed 8 per cent of the total number of fishermen and accounted for 5 per cent of the total catch of the New England section. The fisheries and industries related to the fisheries employed 1,674 persons, which is 14 per cent greater than the number employed during 1924—the most recent year for which comparable data are available. Of the total, 1,259 were fishermen, 34 were employed on transporting vessels, 313 in the wholesale trade, and 68 in the prepared products and by-products industries.

The total catch amounted to 27,666,153 pounds, valued at $2,397-891. This is an increase of 35 per cent in the catch and 32 per cent in value of the catch as compared with the catch and its value for 1924. Of the total value of the catch that for oysters accounted for 27 per cent; lobsters, 15 per cent; hard clams and flounders, each, 8 per cent; and mackeral and scup, each, 7 per cent. Of the total production that for flounders accounted for 16 per cent; oysters, 11 per cent; mackerel, 10 per cent; squid and cod, each, 8 per cent; and scup, 7 per cent.

OPERATING UNITS BY GEAR

The catch of fishery products in the marine waters of Rhode Island during 1928 was taken by 1,259 fishermen, 10 steam vessels, 73 motor vessels, 994 motor and other small fishing boats, and 16 major types of gear. The vessels had a combined capacity of 1,045 net tons.

The fisheries accounting for the greatest number of persons were the lobster pot fishery, employing 402 fishermen and the tong fishery employing 280 fishermen.

CATCH BY GEAR

Four types of gear accounted for 71 per cent of the fish taken in the marine waters of Rhode Island during 1928. Listed in order of their importance they were floating traps which accounted for 33 per cent of the catch; otter trawls, 18 per cent; dredges, 13 per cent; and pots, 7 per cent. The catch by floating traps consisted largely of squid, scup, mackerel, whiting, and butterfish; that by otter trawls chiefly flounders; that by dredges principally oysters; and that by pots almost exclusively lobsters.

OPERATING UNITS BY COUNTIES

Newport County was foremost in the number of persons fishing, accounting for 49 per cent of the total. Washington and Kent Counties followed, each, with 17 per cent. Newport County accounted for 66 per cent of the total number of fishing vessels and Washington accounted for 12 per cent. Newport County also led in the number of motor and other small fishing boats accounting for 39 per cent of the total. Kent County followed with 31 per cent.

CATCH BY COUNTIES

Fishing was prosecuted in the marine waters of five counties in Rhode Island during 1928. Ranked according to value the fisheries of Newport County were most important accounting for 69 per cent of the catch and 48 per cent of the value of the catch. Providence County followed with 8 per cent of the catch and 18 per cent of the value of the catch. Washington County accounted for 17 per cent of the catch and 18 per cent of the value of the catch.

Fisheries of Rhode Island, 1928

OPERATING UNITS: BY GEAR

Items	Purse seines		Haul seines, common	Gill nets			Lines		Pound nets
	Menhaden	Other		Drift	Anchor	Run-around	Trawl	Hand	
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	22	28	22	18			15	70	
On boats and shore—									
Regular			36			5	11	77	53
Casual			9		2			5	
Total	22	28	67	18	2	5	26	152	53
Vessels:									
Steam—									
41 to 50 tons	1		1						
Total	1		1						
Net tonnage	45		45						
Motor—									
5 to 10 tons		4		2			2	24	
11 to 20 tons		4		3			2	3	
Total		8		5			4	27	
Net tonnage		89		55			40	213	
Total vessels	1	8	1	5			4	27	
Total net tonnage	45	89	45	55			40	213	
Boats:									
Motor			5		2	1	7	57	17
Other			14			1		2	48
Apparatus:									
Number	1	8	15	246	8	1	470	224	64
Length, yards	400	1,000	1,485						
Square yards				96,422	1,200	12,000			
Hooks, baits or snoods							27,440	232	

Fisheries of Rhode Island, 1928—Continued

OPERATING UNITS: BY GEAR—Continued

Items	Floating traps	Fyke nets	Dip nets	Otter trawls	Pots			Harpoons, swordfish	Spears
					Eel	Lobster	Periwinkle and cockle		
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels				156		29		93	
On boats and shore—									
Regular	141	6	13	35	24	300	5	30	15
Casual	3	3		1	14	73			23
Total	144	9	13	192	38	402	5	123	38
Vessels:									
Steam—									
5 to 10 tons				3					
11 to 20 tons				2					
41 to 50 tons				1					
Total				6					
Net tonnage				94					
Motor—									
5 to 10 tons				35		13		26	
11 to 20 tons				11		1		6	
21 to 30 tons				2					
Total				48		14		32	
Net tonnage				450		107		265	
Total vessels				54		14		32	
Total net tonnage				544		107		265	
Boats:									
Motor	16	7	9	23	30	265	4	14	1
Other	73	2	1		3	42			18
Apparatus:									
Number	58	63	13	77	1,565	36,925	300	47	38
Yards at mouth				2,021					

Items	Dredges		Tongs	Rakes	Hoes	Total, exclusive of duplication
	Oyster	Scallop				
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	76	17	5			263
On boats and shore—						
Regular	1	82	172	80		731
Casual		40	103	37	3	265
Total	77	139	280	117	3	1,259
Vessels:						
Steam—						
5 to 10 tons		1				3
11 to 20 tons						2
21 to 30 tons	1					1
41 to 50 tons	1					2
51 to 60 tons	1					1
61 to 70 tons	1					1
Total	4	1				10
Net tonnage	191	8				285
Motor—						
5 to 10 tons	3	1	3			49
11 to 20 tons	8	2				20
21 to 30 tons	1	1				3
51 to 60 tons	1					1
Total	13	4	3			73
Net tonnage	217	64	19			760
Total vessels	17	5	3			83
Total net tonnage	408	72	19			1,045
Boats:						
Motor	1	67	159	49		526
Other	1	9	252	58		468
Apparatus:						
Number	35	290	209	93	3	
Yards at mouth	50	238				

Fisheries of Rhode Island, 1928—Continued

CATCH: By gear

Species	Purse seines				Haul seines, common		Gill nets			
	Menhaden		Other				Drift		Anchor	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Eels					8,500	$1,160				
Flounders					2,282	201				
Herring, sea					123,700	2,684				
Mackerel			660,000	$29,125			180,300	$10,818		
Menhaden	1,700,000	$17,000								
Squeteagues					220	17				
Striped bass					2,520	756			240	$72
Suckers					32	3				
Tautog					3,600	285			1,800	164
White perch					470	122				
Total	1,700,000	17,000	660,000	29,125	141,324	5,228	180,300	10,818	2,040	236

Species	Gill nets, run around		Lines				Pound nets	
			Trawl		Hand			
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives							99,400	$1,995
Bluefish	1,200	$240			200	$32	1,170	117
Bonito							450	45
Butterfish							183,360	20,569
Cod			242,973	$15,731	1,562,182	88,441	2,541	116
Cunners					1,200	36	4,925	89
Eels							72,175	6,643
Flounders			31,250	3,125	8,350	810	123,137	7,286
Grayfish							2,100	21
Haddock			173,118	6,293	70,796	2,596		
Hake					13,973	632	27,076	1,155
Herring, sea							72,250	1,256
Hickory shad							1,330	82
King whiting							285	16
Mackerel					358,930	52,795	153,450	7,094
Menhaden							16,250	163
Pollock			462	15	29,190	800	19,641	1,647
Salmon							25	5
Scup							66,510	6,133
Sea bass					210	21	16,035	1,603
Sea robin							39,310	355
Shad							200	21
Sharks							1,990	14
Skates					17,470	373	40,650	497
Smelt							16,608	3,454
Spot							1,050	63
Squeteagues	1,200	120					21,145	1,440
Striped bass					500	120	5,715	933
Sturgeon							25	4
Tautog					36,168	2,807	58,667	3,867
Tomcod							4,960	161
Tuna or horse mackerel					11,250	1,125	10,000	960
White perch							1,266	127
Whiting							158,705	2,492
Squid							300,042	5,563
Total	2,400	360	447,803	25,164	2,110,419	150,588	1,522,443	75,986

Fisheries of Rhode Island, 1928—Continued

CATCH: BY GEAR—Continued

Species	Floating traps		Fyke nets		Dip nets		Otter trawls	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	62, 010	$1, 360						
Bluefish	32, 808	5, 512						
Bonito	48, 500	4, 839						
Butterfish	745, 543	87, 899					40	$4
Cod	307, 049	9, 254					142, 244	5, 447
Cunners	16, 080	384			38, 750	$1, 530	15, 300	159
Eels	6, 435	674	5, 000	$600			1, 250	100
Flounders	365, 193	32, 634	16, 100	749			3, 854, 630	154, 978
Frigate mackerel	5, 336	349						
Goosefish	2, 400	48					40, 730	859
Grayfish	24, 344	252					1, 155	21
Haddock	5, 367	210					327, 506	8, 095
Hake	59, 982	1, 539					11, 446	391
Halibut							376	34
Herring, sea	25, 490	321						
Hickory shad	8, 260	475						
King whiting	2, 670	140						
Mackerel	1, 343, 519	58, 912						
Menhaden	10, 400	104						
Pollock	115, 841	6, 011					1, 617	44
Salmon	67	23						
Scup	1, 936, 856	150, 632						
Sea bass	55, 805	5, 578						
Sea robin	428, 417	3, 927					420	6
Shad	5, 481	432						
Sharks	14, 810	149						
Skates	57, 980	930					504, 730	7, 835
Skipper or "billfish"	300	105						
Smelt	110	27						
Spot	4, 070	280						
Squeteagues	47, 567	3, 033						
Striped bass	35, 372	4, 999						
Sturgeon	100	15						
Tautog	37, 863	3, 072	14, 850	742			420	25
Tomcod	420	8						
Tuna or horse mackerel	6, 208	594						
Whitebait	300	105						
White perch	210	21						
Whiting	1, 216, 711	18, 485					1, 800	36
Wolffish							165	5
Lobsters							200	56
Squid	2, 010, 562	31, 559						
Total	9, 046, 436	434, 891	35, 950	2, 091	38, 750	1, 530	4, 904, 029	178, 095

Species	Pots						Harpoons, swordfish		Spears	
	Eel		Lobster		Periwinkle and cockle					
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Eels	151, 940	$17, 532							8, 500	$1, 150
Swordfish							774, 324	$139, 428		
Tautog			500	$40						
Tuna or horse mackerel							15, 360	1, 280		
Crabs, hard			274, 667	8, 868						
Lobsters			1, 637, 459	357, 047						
Periwinkles			420	84	6, 300	$1, 260				
Total	151, 940	17, 532	1, 913, 046	366, 039	6, 300	1, 260	789, 684	140, 708	8, 500	1, 150

Species	Dredges				Tongs		Rakes		Hoes	
	Oyster		Scallop							
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Clams, hard, public	17, 680	$6, 630			391, 792	$145, 656	130, 304	$47, 324		
Clams, soft, public							13, 280	2, 856	550	$110
Mussels	130, 000	1, 300								
Oysters, market, public					1, 400	400				
Oysters, market, private	2, 920, 197	655, 659			2, 800	800				
Oysters, seed, private	323, 946	40, 777								
Scallops, bay	600	400	42, 270	$28, 188						
Scallops, sea			29, 970	9, 990						
Total	3, 392, 423	704, 766	72, 240	38, 178	395, 992	146, 856	143, 584	50, 180	550	110

Fisheries of Rhode Island, 1928—Continued

OPERATING UNITS: BY COUNTIES

Items	Bristol	Kent	Newport	Providence	Washington
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	26	4	164	45	24
On boats and shore—					
Regular	42	119	393	36	141
Casual	19	92	60	43	51
Total	87	215	617	124	216
Vessels:					
Steam—					
5 to 10 tons			3		
11 to 20 tons			2		
21 to 30 tons				1	
41 to 50 tons			1	1	
51 to 60 tons				1	
61 to 70 tons				1	
Total			6	4	
Net tonnage			94	191	
Motor—					
5 to 10 tons	3	1	36	2	7
11 to 20 tons	4	1	11	1	3
21 to 30 tons	1		2		
51 to 60 tons				1	
Total	8	2	49	4	10
Net tonnage	110	18	457	86	89
Total vessels	8	2	55	8	10
Total net tonnage	110	18	551	277	89
Boats:					
Motor	30	140	219	26	111
Other	34	164	164	37	69
Apparatus:					
Purse seines—					
Menhaden			1		
Yards			400		
Other			7		1
Yards			880		120
Haul seines, common	1		10	2	2
Yards	100		980	200	205
Gill nets—					
Drift			246		
Square yards			96,422		
Anchor					8
Square yards					1,200
Runaround					1
Square yards					12,000
Lines—					
Trawl			426		44
Hooks			23,640		3,800
Hand	4	1	157	10	52
Hooks	8	1	161	10	52
Pound nets		1	43		20
Floating traps			41		17
Fyke nets		50			13
Dip nets	2		11		
Otter trawls	1		56	1	19
Yards at mouth	20		1,519	15	467
Pots—					
Eel	75	210	470	95	715
Lobster	2,440	1,085	23,210	600	9,590
Periwinkle and cockle	150		150		
Harpoons, swordfish			40	2	5
Spears	4	6	19	8	1
Dredges—					
Oyster	16	3		12	4
Yards at mouth	22	4		18	6
Scallop	12	175	26	5	72
Yards at mouth	9	136	33	4	56
Tongs	21	125	15	22	26
Rakes	3	30	29	27	4
Hoes		3			

Fisheries of Rhode Island, 1928—Continued

CATCH: BY COUNTIES

Species	Bristol		Kent		Newport		Providence		Washington	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives					114,570	$2,310			46,840	$1,045
Bluefish					30,838	5,268			4,540	633
Bonito					44,710	4,460			4,240	424
Butterfish					810,593	96,205			118,350	12,267
Cod	2,210	$131			2,026,492	103,562	41,000	$2,870	187,287	12,426
Cunners	2,000	60			42,155	1,622			32,100	516
Eels	8,000	1,228	15,200	$1,976	104,010	10,146	19,920	2,755	106,670	11,754
Flounders	5,850	468	11,600	715	3,394,210	140,461	2,000	160	987,282	57,979
Frigate mackerel					3,936	236			1,400	113
Goosefish					11,640	233			31,490	674
Grayfish					2,175	39			25,424	255
Haddock					574,005	17,091			2,782	103
Hake					79,455	3,249			33,022	468
Halibut					376	34				
Herring, sea	1,500	30			208,540	4,110			11,400	121
Hickory shad					1,760	135			7,830	422
King whiting					175	17			2,780	139
Mackerel					2,443,799	148,032			252,400	10,712
Menhaden					1,703,600	17,036			23,050	231
Pollock					152,900	8,103			13,851	414
Salmon					12	12			80	16
Scup					1,825,491	146,093			177,875	10,672
Sea bass					66,470	6,644			5,580	558
Sea robin					335,147	2,958			133,000	1,330
Shad					3,391	135			2,290	318
Sharks					7,900	79			8,900	84
Skates					400,930	7,378	4,000	30	215,900	2,227
Skipper or "bill-fish"					300	105				
Smelt					2,758	689			13,960	2,792
Spot					1,050	125			4,070	218
Squeteagues					33,462	2,137			36,670	2,473
Striped bass					19,707	2,335			24,640	4,545
Sturgeon					100	15			25	4
Suckers									32	3
Swordfish					711,951	127,747	9,348	1,210	53,025	10,471
Tautog	4,700	376	17,150	927	80,700	5,660	1,600	125	49,718	3,914
Tomcod					3,230	93			2,150	76
Tuna or horse mackerel					40,818	3,759			2,000	200
Whitebait					300	105				
White perch					1,260	126			686	144
Whiting					1,220,316	19,434			156,900	1,579
Wolffish					165	5				
Crabs, hard	230,000	7,528			44,667	1,340				
Lobsters	50,550	15,165	21,300	6,008	1,050,309	186,176	13,200	3,960	502,300	145,794
Squid					1,463,104	24,997			847,500	12,125
Clams, hard, public	61,200	22,950	329,064	122,389	78,712	27,721	31,720	11,895	39,080	14,655
Clams, soft, public	1,300	260	550	110	2,000	600	9,100	1,820	880	176
Mussels							70,000	700	60,000	600
Oysters, market, public									1,400	400
Oysters, market, private	864,906	191,087	28,000	8,000			1,572,291	363,572	457,800	93,800
Oysters, seed, private							323,946	40,777		
Periwinkles	3,500	700			3,220	644				
Scallops, bay	3,000	2,200	33,192	21,380	1,470	1,102	360	270	4,848	3,636
Scallops, sea					29,970	9,990				
Total	1,238,716	242,183	456,056	161,505	19,178,849	1,140,553	2,098,485	430,144	4,694,047	423,506

INDUSTRIES RELATED TO THE FISHERIES

Transporting trade.—In 1928 there were 34 persons in Rhode Island engaged primarily in transporting the catch of fish. In this trade 1 steam vessel and 10 motor vessels, having a combined capacity of 197 net tons, were operated. The size of vessel in most popular use ranged from 5 to 10 net tons.

Wholesale trade.—There were 31 wholesale establishments in Rhode Island engaged chiefly in handling fresh and frozen fishery products.

This is 10 per cent of the total number of such establishments in the New England section. They employed 313 persons who received $291,648 in salaries and wages.

Prepared and by-products trade.—There were two establishments in Rhode Island engaged primarily in the manufacture of the prepared fishery products or by-products. This is 1 per cent of the total number in the New England section. They employed 68 persons who received $50,279 in salaries and wages. The products manufactured, consisting of clam products, oyster-shell products, and cured fish, were valued at $348,299. Detailed statistics of most of the items may be obtained from "Fishery Industries of the United States, 1928," Bureau of Fisheries Document No. 1067.

Industries related to the fisheries of Rhode Island, 1928

TRANSPORTING

Items	Number
Men on transporting vessels	34
Transporting vessels	
Steam	1
Net tonnage	49
Motor—	
5 to 10 tons	6
11 to 20 tons	3
51 to 60 tons	1
Total	10
Net tonnage	148
Total vessels	11
Total net tonnage	197

WHOLESALE FISHERY TRADE

Items	Bristol County	Kent County	Newport and Washington Counties	Providence County	Total
Establishments	7	6	13	5	31
Persons engaged:					
Proprietors	6	7	16	8	37
Salaried employees	10	3	10	8	31
Wage earners	68	16	65	96	245
Paid to salaried employees	$18,482	$4,060	$26,626	$43,029	$92,197
Paid to wage earners	51,320	23,384	56,599	68,148	199,451
Total salaries and wages	69,802	27,444	83,225	111,177	291,648

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS

Items	Number	Products	Value
Establishments	2	Miscellaneous products [1]	$348,299
Persons engaged:			
Proprietors	2		
Salaried employees	3		
Wage earners	63		
Paid to salaried employees	$18,300		
Paid to wage earners	31,979		
Total salaries and wages	50,279		

[1] Includes clam chowder, lime, poultry grit, and salted and smoked fish. Since this item includes salted and smoked fish and oyster-shell products prepared by three firms whose activities were principally in the wholesale fishery trade, data on persons engaged, salaries, and wages are included under that section.

CONNECTICUT

Connecticut in 1928 employed 12 per cent of the total number of fishermen and accounted for 12 per cent of the total catch of the New England section. The fisheries and industries related to the fisheries employed 2,499 persons, which is 49 per cent greater than the number in 1924—the most recent year for which comparable data are available. Of the total, 2,000 were fishermen, 7 were employed on transporting vessels, 213 in the wholesale trade, and 279 in the prepared-products and by-products industries.

The total catch amounted to 72,198,284 pounds, valued at $3,296,-611. This is an increase of 180 per cent in the catch and 64 per cent in the value of the catch as compared with the catch and its value for 1924. The large increases in Connecticut are accounted for by the fact that a large packing plant was established in Connecticut in the fall of 1927 and now diverts a large portion of the catch which formerly was landed in New York City. Of the total value of the catch, that for haddock accounted for 44 per cent; oysters, 23 per cent; lobsters, 7 per cent; and cod, 4 per cent. Of the total production that of haddock accounted for 66 per cent; flounders, 11 per cent; oysters, 7 per cent; cod, 6 per cent; and menhaden, 5 per cent.

OPERATING UNITS BY GEAR

The catch of fishery products along the coast of Connecticut during 1928 was taken by 2,000 fishermen who used 25 steam vessels, 91 motor vessels, 5 sailing vessels, 1,038 motor and other small fishing boats, and 16 major types of gear. The vessels had a combined capacity of 5,566 net tons.

The fisheries accounting for the greatest number of persons were the otter-trawl fishery, employing 736 fishermen and the lobster-pot fishery, employing 380 fishermen.

CATCH BY GEAR

Two types of gear accounted for 90 per cent of the fish taken in the marine fisheries of Connecticut during 1928. Otter trawls were by far the most important of these accounting for 83 per cent of the catch. Oyster dredges followed with 7 per cent. The catch by otter trawls consisted principally of haddock, flounders, and cod; and that by dredges was exclusively oysters.

OPERATING UNITS BY COUNTIES

New London County was foremost in the number of persons fishing, accounting for 58 per cent of the total. Fairfield County followed with 16 per cent. New London County also led in the number of fishing craft, accounting for 43 per cent of the vessels and 51 per cent of the motor and other small fishing boats. Fairfield County ranked second with 37 per cent of the vessels and 17 per cent of the motor and other small fishing boats.

CATCH BY COUNTIES

Fishing was prosecuted in the marine waters of five counties of Connecticut during 1928. Ranked according to value the fisheries of New London County were by far the most important, accounting for 90 per cent of the total catch and 7 per cent of the total value of the catch. Fairfield County accounted for 5 per cent of the total catch and 14 per cent of the value and New Haven County accounted for 4 per cent of the catch and 14 per cent of the value.

Fisheries of Connecticut, 1928

OPERATING UNITS: BY GEAR

Items	Purse seines: Menhaden	Purse seines: Other	Haul seines, common	Gill nets: Drift	Gill nets: Stake	Lines: Trawl	Lines: Hand
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:							
On vessels	56	40				14	23
On boats and shore—							
Regular		20	42	3	1	60	139
Casual			105	96	10		15
Total	56	60	147	99	11	74	177
Vessels:							
Steam—							
101 to 110 tons	1						
161 to 170 tons	1						
Total	2						
Net tonnage	268						
Motor—							
5 to 10 tons		3					1
11 to 20 tons		2					3
21 to 30 tons		1				1	1
41 to 50 tons		1				1	
Total		7				2	5
Net tonnage		116				69	69
Total vessels	2	7				2	5
Total net tonnage	268	116				69	69
Boats:							
Motor		6	16	34	6	30	98
Other		10	50	22	6		81
Apparatus:							
Number	2	13	85	41	26	11, 100	189
Length, yards	930	850	4, 017				
Square yards				99, 500	3, 300		
Hooks, baits or snoods						555, 000	374

Items	Pound nets	Weirs	Fyke nets	Dip nets	Otter trawls	Box traps	Pots: Crab	Pots: Eel
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:								
On vessels					445			
On boats and shore—								
Regular	32	2	8	3	291			64
Casual	1	2	38	49		2	2	36
Total	33	4	46	52	736	2	2	100
Vessels:								
Steam—								
121 to 130 tons					2			
161 to 170 tons					3			
171 to 180 tons					2			
181 to 190 tons					1			
201 to 210 tons					8			
Total					16			
Net tonnage					2, 956			
Motor—								
5 to 10 tons					25			
11 to 20 tons					15			
Total					40			
Net tonnage					394			
Total vessels					56			
Total net tonnage					3, 350			
Boats:								
Motor	14	2	10	4	122	1	1	37
Other	23	2	31	24	20			71
Apparatus:								
Number	25	5	186	48	178	2	60	1, 687
Yards at mouth					2, 020			

Fisheries of Connecticut, 1928—Continued

OPERATING UNITS: BY GEAR—Continued

Items	Pots, lobster	Harpoons, swordfish	Spears	Dredges, oyster	Tongs	Rakes	Total, exclusive of duplication
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	4	28		237			756
On boats and shore—							
Regular	372	24	31	40	28	49	871
Casual	4		14		37	32	373
Total	380	52	45	277	65	81	2,000
Vessels:							
Steam—							
11 to 20 tons				1			1
71 to 80 tons				1			1
91 to 100 tons				1			1
101 to 110 tons				1			2
111 to 120 tons				1			1
121 to 130 tons							2
161 to 170 tons							4
171 to 180 tons							2
181 to 190 tons							1
201 to 210 tons							8
311 to 320 tons				1			1
391 to 400 tons				1			1
Total				7			25
Net tonnage				1,121			4,345
Motor—							
5 to 10 tons	2	3		22			49
11 to 20 tons		3		13			28
21 to 30 tons				8			9
31 to 40 tons				2			2
41 to 50 tons				2			3
Total	2	6		47			91
Net tonnage	13	58		709			1,185
Sail—							
5 to 10 tons				4			4
11 to 20 tons				1			1
Total				5			5
Net tonnage				36			36
Total vessels	2	6		59			121
Total net tonnage	13	58		1,866			5,566
Boats:							
Motor	240	17	19	27	17	3	532
Other	158	1	45	36	56	49	506
Apparatus:							
Number	22,750	18	45	216	65	81	
Yards at mouth				235			

CATCH: BY GEAR

Species	Purse seines				Haul seines, common	
	Menhaden		Other			
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives					3,850	$75
Carp					2,535	379
Catfish and bullheads					100	5
Eels					1,000	150
Flounders					60	6
Herring, sea					2,800	70
Mackerel			1,118,650	$80,669		
Menhaden	3,414,700	$55,318				
Minnows					16,432	5,128
Mummichog					5,010	623
Shad					55,376	4,971
Smelt					8,470	1,093
Suckers					3,200	238
Total	3,414,700	55,318	1,118,650	80,669	98,833	12,738

Fisheries of Connecticut, 1928—Continued

CATCH: BY GEAR—Continued

Species	Gill nets				Lines			
	Drift		Stake		Trawl		Hand	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bluefish							5,145	$1,509
Butterfish							608	151
Carp			6,000	$720				
Cod					226,088	$10,005	166,310	8,667
Eels							4,560	637
Flounders					30,900	1,545	7,847	568
Haddock					121,794	4,922	16,000	650
Mackerel							145,350	10,649
Menhaden			2,400	44				
Pollock							1,400	68
Seabass							2,170	441
Shad	140,410	$21,822						
Smelt							110	22
Squeteagues			400	146			500	100
Striped bass	1,200	300					100	25
Tautog			1,400	140			77,343	7,494
Total	141,610	22,122	10,200	1,050	378,782	16,472	427,443	30,981

Species	Pound nets		Weirs		Fyke nets	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	4,810	$84			7,000	$140
Bluefish	105	25				
Butterfish	13,276	1,373				
Carp					5,800	641
Catfish and bullheads					1,100	72
Eels			675	$176	5,439	1,608
Flounders	19,127	1,773			4,520	366
Hickory shad	200	30				
Mackerel	4,900	540				
Menhaden	26,800	478				
Minnows					1,275	86
Mummichog			1,600	500		
Pike					10	2
Salmon	12	6				
Scup	200	4				
Sea robin	10,600	106				
Skates	39,000	390				
Smelt	6,900	920				
Squeteagues	39,685	10,238				
Striped bass	2,517	631				
Sturgeon	25	3				
Suckers					60,006	4,365
Tautog	10,270	1,035			250	25
White perch					50	4
Yellow perch					55	5
Squid	49,400	1,666				
Total	227,827	19,302	2,275	676	85,505	7,314

Species	Dip nets		Otter trawls		Box traps	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	20	$1				
Carp					60	$9
Cod			3,808,742	$113,854		
Cusk			75,024	18,000		
Flounders			7,945,456	352,619		
Grayfish			10,500	200		
Haddock			47,161,480	1,454,739		
Hake			381,200	6,352		
Halibut			4,080	6,112		
Pollock			289,025	8,100		
Sea robin			3,000	30		
Shad	3,277	620				
Skates			365,500	3,803		
Smelt	1,311	191				
Sturgeon			177	23		
Suckers	25	2				
Tautog			200	18		
Whiting			1,200	12		
Crabs, soft	1,065	400				
Crabs, hard	10,090	1,194				
Lobsters			50	18		
Total	15,788	2,408	60,045,634	1,963,880	60	9

Fisheries of Connecticut, 1928—Continued

CATCH: BY GEAR—Continued

Species	Pots					
	Crab		Eel		Lobster	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Eels			65, 302	$8, 635		
Crabs, hard	170, 660	$5, 090				
Lobsters					693, 508	$240, 963
Total	170, 660	5, 090	65, 302	8, 635	693, 508	240, 963

Species	Harpoons, swordfish		Spears		Oyster dredges	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Eels			16, 790	$2, 349		
Sharks	1, 000	$10				
Swordfish	168, 442	31, 109				
Oysters, market, public					10, 500	$3, 000
Oysters, market, private					839, 804	197, 414
Oysters, seed, public					349, 524	49, 932
Oysters, seed, private					3, 774, 274	514, 034
Total	169, 442	31, 119	16, 790	2, 349	4, 974, 102	764, 380

Species	Tongs		Rakes	
	Pounds	*Value*	*Pounds*	*Value*
Clams, hard, public	9, 824	$3, 694	19, 984	$7, 494
Clams, hard, private			1, 200	450
Clams, soft, public			38, 310	7, 783
Oysters, market, public	3, 150	900	420	180
Oysters, market, private	4, 410	1, 260	1, 750	500
Oysters, seed, public	55, 125	7, 875		
Oysters, seed, private	7, 000	1, 000		
Total	79, 509	14, 729	61, 664	16, 407

OPERATING UNITS: BY COUNTIES

Items	Fairfield	Hartford	Middlesex	New Haven	New London
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	147			112	497
On boats and shore—					
Regular	118		68	116	569
Casual	50	118	82	35	88
Total	315	118	150	263	1, 154
Vessels:					
Steam—					
11 to 20 tons				1	
71 to 80 tons	1				
91 to 100 tons	1				
101 to 110 tons				1	1
111 to 120 tons	1				
121 to 130 tons					2
161 to 170 tons					4
171 to 180 tons					2
181 to 190 tons					1
201 to 210 tons					8
311 to 320 tons				1	
391 to 400 tons				1	
Total	3			4	18
Net tonnage	289			832	3, 224

Fisheries of Connecticut, 1928—Continued

OPERATING UNITS: BY COUNTIES—Continued

Items	Fairfield	Hartford	Middlesex	New Haven	New London
Vessels—Continued.					
Motor—	*Number*	*Number*	*Number*	*Number*	*Number*
5 to 10 tons	24			6	19
11 to 20 tons	6			9	13
21 to 30 tons	5			3	1
31 to 40 tons				2	
41 to 50 tons	2				1
Total	37			20	34
Net tonnage	483			321	381
Sail—					
5 to 10 tons	4				
11 to 20 tons	1				
Total	5				
Net tonnage	36				
Total vessels	45			24	52
Total net tonnage	808			1, 153	3, 605
Boats:					
Motor	84	4	80	73	291
Other	93	32	70	76	235
Apparatus:					
Purse seines—					
Menhaden					2
Yards					930
Other					13
Yards					850
Haul seines, common	14	29	7	10	25
Yards	405	2, 072	230	180	1, 130
Gill nets—					
Drift		3	27		11
Square yards		7, 425	66, 825		25, 250
Stake	1		12	13	
Square yards	100		1, 200	2, 000	
Lines—					
Trawl					11, 100
Hooks					555, 000
Hand	12		38	13	126
Hooks	24		76	26	248
Pound nets				1	24
Weirs	5				
Fyke nets	4	101	23	1	57
Dip nets		22			26
Otter trawls	15		19	17	127
Yards at mouth	215		125	355	1, 325
Box traps			2		
Pots:					
Crab					60
Eel	115	38	334	143	1, 057
Lobster	2, 729		1, 629	2, 815	15, 577
Harpoons, swordfish			1		17
Spears			1	4	40
Dredges, oyster	168			48	
Yards at mouth	159			76	
Tongs	27		8	26	4
Rakes	32		5	27	17

CATCH: BY COUNTIES

Species	Fairfield		Hartford		Middlesex		New Haven		New London	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives			7, 020	$141	2, 000	$40			6, 660	$119
Bluefish					4, 101	1, 253	1, 044	$256	105	25
Butterfish							1, 200	120	12, 684	1, 404
Carp			2, 300	396	9, 060	1, 154			3, 035	199
Catfish and bullheads					100	5			1, 100	72
Cod	129, 835	$7, 808							4, 071, 305	124, 718
Cusk									75, 024	18, 000
Eels	9, 225	1, 644	1, 019	257	17, 505	2, 376	8, 443	1, 223	57, 574	8, 055
Flounders	600, 669	34, 110			95, 750	4, 610	258, 558	12, 853	7, 052, 993	305, 304
Grayfish									10, 500	200
Haddock	78, 900	4, 092							47, 220, 374	1, 456, 219
Hake									381, 200	6, 352

Fisheries of Connecticut, 1928—Continued

CATCH: BY COUNTIES—Continued

Species	Fairfield		Hartford		Middlesex		New Haven		New London	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Halibut									4,080	$6,112
Herring, sea	2,800	$70								
Hickory shad									200	30
Mackerel	200	20							1,268,700	91,838
Menhaden							4,400	$64	3,439,500	55,776
Minnows	7,220	1,461	4,451	$1,586	4,150	$1,508	608	569	1,278	90
Mummichog	1,600	500			1,950	405	60	6	3,000	212
Pike									10	2
Pollock					721	36			289,704	8,132
Salmon									12	6
Scup									200	4
Seabass							50	12	2,120	429
Sea robin									13,600	136
Shad			59,203	5,694	110,564	16,762			29,296	4,957
Sharks									1,000	10
Skates					47,000	470	7,000	70	350,500	3,653
Smelt									16,791	2,226
Squeteagues					500	100	2,400	326	37,685	10,058
Striped bass	100	25							3,717	931
Sturgeon					100	10			102	16
Suckers			32,828	2,402	22,223	1,698	400	40	7,780	465
Swordfish					1,642	365			166,800	30,744
Tautog	1,498	168			12,547	1,301	9,650	1,013	65,768	6,230
White perch									50	4
Whiting									1,200	12
Yellow perch									55	5
Crabs, hard									180,750	6,284
Crabs, soft									1,065	400
Lobsters	55,556	26,837			40,725	16,496	97,094	42,940	500,183	154,708
Squid									49,400	1,666
Clams, hard, public	14,240	5,340					14,400	5,400	1,168	448
Clams, hard, private	1,200	450								
Clams, soft, public	16,750	3,350			850	170	18,050	3,610	2,660	653
Oysters, market, public	10,500	3,000			2,100	600	1,050	300	420	180
Oysters, market, private	522,536	106,766					323,428	92,408		
Oysters, seed, public	365,974	52,282			12,600	1,800	26,075	3,725		
Oysters, seed, private	1,674,666	214,090					2,106,608	300,944		
Total	3,493,469	462,013	106,821	10,476	386,188	51,159	2,880,518	465,879	65,331,288	2,307,084

INDUSTRIES RELATED TO THE FISHERIES

Transporting trade.—In 1928 there were seven persons in Connecticut engaged primarily in transporting the catch of fish. In this trade five motor vessels having a capacity of 75 net tons were operated. The size of vessel in popular use ranged from 5 to 10 net tons.

Wholesale trade.—There were 18 wholesale establishments along the coast of Connecticut engaged chiefly in handling fresh and frozen products. This is 6 per cent of the total number of such establishments in the New England section. These establishments employed 213 persons, who received $340,413 in salaries and wages. These establishments were confined to three counties, New Haven having 7; New London, 6; and Fairfield, 5.

Prepared and by-products trade.—There were three establishments along the coast of Connecticut engaged primarily in the manufacture of prepared canned and cured fishery products or by-products. This is 2 per cent of the total number in the New England section. They employed 279 persons who received $331,320 in salaries and wages. The products manufactured, consisting entirely of menhaden products and fishery by-products, were valued at $704,900. Detailed statistics of most of the items manufactured may be obtained from "Fishery Industries of the United States, 1928," Bureau of Fisheries Document No. 1067.

Industries related to the fisheries of Connecticut, 1928

TRANSPORTING

Items	Number	Items	Number
Men on transporting vessels	7	Transportating vessels—Con.	
Transporting vessels:		Motor—Con.	
Motor—		31 to 40 tons	1
5 to 10 tons	3	Total vessels	5
11 to 20 tons	1	Total net tonnage	75

WHOLESALE FISHERY TRADE

Items	Fairfield County	New Haven County	New London County	Total
Establishments	5	7	6	18
Persons engaged:				
Proprietors	7	8	2	17
Salaried employees	4	4	6	14
Wage earners	133	20	29	182
Paid to salaried employees	$22,500	$23,872	$20,449	$66,821
Paid to wage earners	205,140	26,460	41,992	273,592
Total salaries and wages	227,640	50,332	62,441	340,413

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS

Items	Number	Products	Value
Establishments	3	Miscellaneous products [1]	$280,274
Persons engaged:			
Proprietors	3		
Salaried employees	20		
Wage earners	256		
Paid to salaried employees	$53,222		
Paid to wage earners	278,098		
Total salaries and wages	331,320		

[1] Includes menhaden products, fish meal from ground fish, cod-liver oil and oyster-shell products. Since this item includes oyster-shell products prepared by one firm whose activities were principally in the wholesale fishery trade, data on persons engaged, salaries and wages are included under that section.

HISTORICAL REVIEW

Eleven general surveys have been made for statistics of the fisheries of the New England States during the 48 years from 1880 to 1928. These have not been as frequent as might be desired, but a rather clear picture of the trend of the fisheries in this district is obtainable from the records, which are published in comparable form in the following pages. Those years for which statistical surveys have been made are used as a basis for the following discussions. It should be borne in mind, however, that in certain of those years when surveys were not made there may have been unusual fluctuations for certain species. In some of the surveys prior to 1889 the fisheries of certain States were not canvassed, and in certain of the States that were canvassed several of the species were included with "miscellaneous fish," or "all other species." For this reason totals are not usually shown prior to 1889.

COMPARISON OF CATCH RECORDS

Total catch.—The most recent records for the New England States, which are for the year 1928, show a larger catch than in any year during the period 1880 to 1928. The catch in 1887 amounted to 520,214,000 pounds, it decreased to 393,458,000 in 1898, but in 1928 rose to 603,598,000 pounds.

Alewives.—The catch of alewives in 1928 was less than in any year for which there are records, amounting to 4,557,000 pounds. The largest catch was registered in 1896 when 12,116,000 pounds were taken.

Butterfish.—The catch of butterfish in recent years has exceeded that in earlier years, in 1928 being greater than for any year on record, amounting to 1,549,000 pounds. The smallest catch recorded was that made in 1905, and amounted to only 451,000 pounds.

Cod.—The first available figures on the catch of cod are those for 1887 when 207,458,000 pounds were taken. The trend since then has been downward, and no catch has been as great. The production in 1928 amounted to 90,336,000 pounds.

Cusk.—The catch of cusk in 1887 amounted to 1,120,000 pounds which is the smallest on record. The largest catch was registered in 1905 when 9,609,000 pounds were taken. That in 1928 amounted to 3,230,000 pounds.

Flounders.—Beginning with a catch of 2,480,000 pounds in 1887, the production has constantly increased, and in 1928 amounted to 50,274,000 pounds.

Haddock.—By far the largest catch of haddock was made in 1928 when 237,708,000 pounds were taken. In no other year for which there are records had the catch amounted to as much as 100,000,000 pounds. The smallest catch registered was made in 1887, when 40,806,000 pounds were taken.

Hake.—Beginning with a catch of 20,333,000 pounds in 1887, the trend in this species was upward until 1898 when 39,824,000 pounds were taken. Since then the trend has been almost constantly downward and in 1928 amounted to 17,506,000 pounds.

Halibut.—During the period 1887 to 1902 the catch of halibut varied between 11,000,000 and 14,000,000 pounds. Since then no catch has amounted to as much as 5,000,000 pounds. The catch in 1928 amounted to 4,257,000 pounds.

Herring.—Considerable fluctuation in the catch of herring has been noted. The smallest catch was made in 1887, amounting to 42,817,000 pounds. The largest catch on record was made in 1902 when 200,598,000 pounds were taken. That in 1928 amounted to 70,555,000 pounds.

Mackerel.—The erratic appearance of mackerel in New England waters is reflected in the large variations in the catch throughout the period under review. The catch in 1887 amounted to 33,099,000 pounds; that in 1898, 9,881,000 pounds; and that in 1928, which is the largest catch on record, amounted to 42,722,000 pounds.

Menhaden.—Reaching a peak of 173,803,000 pounds in 1889 the trend of the menhaden fisheries has been downward and in 1928 the smallest catch on record was registered, amounting to 5,175,000 pounds.

Pollock.—The smallest catch of pollock on record was made in 1887, amounting to 6,645,000 pounds. Almost constant increases were made until 1905 when the catch amounted to 29,556,000 pounds. In 1928 the production decreased to 11,039,000 pounds.

Scup.—The largest catch of scup was made in 1889, amounting to 8,572,000 pounds. The smallest catch was registered in 1924 when 1,352,000 pounds were taken. A recovery was effected in 1928 when the catch amounted to 2,859,000 pounds.

Skates.—The first available records on the catch of skates are for 1905. The catch in that year amounted to 26,000 pounds. Since then this fishery has constantly expanded, and in 1928 the catch amounted to 1,058,000 pounds.

Smelt.—During the period of 1887 to 1902 the catch of smelt consistently exceeded 1,100,000 pounds, and 1892 reached a peak of 1,698,000 pounds. Since 1902 no catch has been as great as 1,000,000 pounds. However, that in 1928 amounted to 903,000 pounds.

Swordfish.—The smallest catch of swordfish that has been recorded was made in 1887, amounting to 685,000 pounds. The trend has been generally upward and in 1928 the largest catch on record was made, amounting to 4,366,000 pounds.

Whiting.—In 1887 only 47,000 pounds of this species were taken. By 1919 it amounted to 16,203,000 pounds. However, in 1928 the catch decreased and amounted to 8,378,000 pounds.

Crabs.—The crab fishery in New England prior to 1908 was not of great importance, the catch at no time exceeding 88,000 pounds. Since 1908, however, the catch has increased rapidly and in 1928 amounted to 3,755,000 pounds, which is by far the largest on record.

Lobsters.—The trend of the lobster fishery has been downward. The largest catch during the period under review was made in 1889, when 30,450,000 pounds were taken. By 1928 the catch decreased to 11,604,000 pounds.

Squid.—The trend of this fishery has been generally upward. In 1888, 486,000 pounds were taken. In 1928 the catch had increased to 7,927,000 pounds, which is the largest on record.

Hard clams.—Almost constant increases in the catch of hard clams have been reported since 1887. In that year the catch amounted to only 590,000 pounds of meat, while in 1928, 2,232,000 pounds were taken.

Soft clams.—The largest catch of soft clams was taken in 1889 and amounted to 11,542,000 pounds of meat. The catch in 1928 amounted to 5,470,000 pounds.

Oysters.—The catch of oysters in 1928 amounted to 9,373,000 pounds of meat. This is by far the smallest catch on record. The largest catch was registered in 1910, when 41,594,000 pounds were taken.

Scallops.—The scallop fishery in 1888 produced 342,000 pounds of meat and was the smallest catch on record. The largest catch was made in 1908 and amounted to 1,763,000 pounds. That in 1928 was but little less than this peak year and amounted to 1,753,000 pounds.

Considered in general terms over the period reviewed the catches of butterfish, flounders, haddock, mackerel, skates, swordfish, whiting, crabs, squid, hard clams, and scallops have increased; the catches of cusk, herring, pollock, smelt, and soft clams have remained fairly constant; and the catches of alewives, cod, hake, halibut, menhaden, scup, lobsters, and oysters have decreased.

Fisheries of the New England States, 1879 to 1928

CATCH OF CERTAIN SPECIES: BY STATES

[Expressed in thousands of pounds; that is, 000 omitted]

Year	Alewives						Butterfish				
	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total	Maine	Massachusetts	Rhode Island	Connecticut	Total
1879	(1)	(1)	3,751	(1)	(1)	--------	(1)	5	(1)	(1)	------
1880	(1)	425	(1)	2,978	770	--------	(1)	(1)	(1)	(1)	------
1887	2,526	100	4,130	1,430	18	8,204	5	504	266	24	799
1888	2,836	147	6,292	1,589	25	10,889	(1)	513	283	38	------
1889	4,022	140	3,911	1,387	53	9,513	27	763	267	42	1,099
1892	2,276	50	3,651	1,190	681	7,848	(1)	(1)	(1)	(1)	------
1896	3,388	294	5,356	2,077	1,001	12,116	(1)	(1)	(1)	(1)	------
1897 (fiscal)	1,249	239	4,779	(1)	(1)	--------	(1)	(1)	(1)	(1)	------
1898	3,619	325	2,900	1,012	868	8,724	15	31	207	60	------
1902	3,341	475	4,517	705	1,663	10,701	8	106	363	67	544
1905	3,082	122	4,861	599	1,232	9,896	6	83	341	21	451
1908	2,085	121	4,062	288	1,025	7,581	6	67	1,112	102	1,287
1919	1,296	--------	3,064	270	177	4,807	33	297	758	19	1,107
1924	1,583	--------	2,593	391	116	4,683	12	378	685	6	1,081
1928	2,132	--------	2,248	161	16	4,557	25	580	930	14	1,549

Year	Cod						Cusk				
	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total	Maine	New Hampshire	Massachusetts	Connecticut	Total
1879	(1)	(1)	172,217	(1)	(1)	--------	(1)	(1)	989	(1)	------
1880	56,004	5,448	(1)	2,584	2,738	--------	(1)	38	(1)	-------	------
1887	45,020	2,156	157,672	370	2,240	207,458	676	--------	444	-------	1,120
1888	40,252	1,501	152,166	360	2,001	196,280	715	--------	696	-------	1,411
1889	29,017	1,569	131,578	429	1,530	164,123	675	34	1,230	-------	1,939
1897 (fiscal)	11,487	490	105,644	(1)	(1)	--------	1,168	63	3,194	(1)	------
1898	20,556	693	101,999	1,742	451	125,441	1,312	98	6,082	-------	7,492
1902	23,878	442	98,384	690	211	123,605	2,651	20	3,049	-------	5,720
1905	12,261	342	79,537	1,097	555	93,792	1,675	--------	7,934	-------	9,609
1908	20,013	135	72,819	1,497	820	95,284	2,078	--------	4,267	-------	6,345
1919	15,062	98	72,672	1,148	96	89,076	1,046	2	1,595	7	2,650
1924	22,443	98	69,014	1,357	539	93,451	1,569	1	2,716	-------	4,286
1928	16,187	25	67,666	2,257	4,201	90,336	960	10	2,185	75	3,230

Year	Flounders						Haddock					
	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total
1879	(1)	(1)	571	(1)	(1)	-------	(1)	(1)	24,093	(1)	(1)	-------
1880	(1)	(1)	(1)	352	143	-------	17,729	644	(1)	(1)	(1)	-------
1887	659	--------	841	426	554	2,480	8,901	1,020	30,524	96	265	40,806
1888	829	--------	853	558	542	2,782	8,659	1,079	36,810	96	244	46,888
1889	829	--------	958	530	634	2,951	7,809	1,650	36,003	124	206	45,792
1897 (fiscal)	(1)	(1)	(1)	(1)	(1)	-------	6,112	302	33,156	(1)	(1)	-------
1898	787	--------	1,168	1,710	444	4,109	9,188	1,388	35,711	367	113	46,767
1902	569	--------	2,596	1,135	509	4,809	7,364	159	39,812	506	189	48,030
1905	97	--------	4,046	1,143	477	5,763	8,785	63	67,975	516	294	77,633
1908	31	--------	7,124	1,891	707	9,753	10,513	100	48,492	415	24	59,544
1919	470	8	10,262	2,452	2,349	15,541	11,271	19	78,553	10	(2)	89,853
1924	343	--------	22,997	3,099	4,416	30,855	15,559	144	77,684	134	49	93,570
1928	1,175	4	36,686	4,401	8,008	50,274	12,204	50	177,578	577	47,299	237,708

[1] Not available. Prior to 1889 some of these species were included under "Miscellaneous fish" or "All other species."
[2] Less than 500 pounds.

Fisheries of the New England States, 1879 to 1928—Continued

CATCH OF CERTAIN SPECIES: BY STATES—Continued

[Expressed in thousands of pounds; that is, 000 omitted]

Year	Hake						Halibut					
	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total
1879	(1)	(1)	8,438	(1)	(1)		(1)	(1)	14,206	(1)	(1)	
1880	24,448	398	(1)	(1)	(1)		(1)	25	(1)	(1)	830	
1887	14,060	200	6,071		2	20,333	627	156	10,367		472	11,622
1888	14,948	229	5,809		2	20,988	551	143	11,882		351	12,927
1889	13,333	447	7,209		1	20,990	501	88	10,862		265	11,716
1897 (fiscal)	9,290	316	11,093	(1)	(1)		272	5	11,861	(1)	(1)	
1898	18,141	118	21,565			39,824	305		12,383			12,688
1902	20,726	49	14,836			35,611	210		13,366			13,576
1905	15,309	21	21,092		2	36,424	118		3,989		85	4,192
1908	17,398	13	16,781	2		34,194	200		4,146		8	4,354
1919	16,118	3	4,125		10	20,256	19		1,725		25	1,969
1924	11,724	25	6,740	38	3	18,530	142	(2)	4,361			4,503
1928	7,681	10	9,322	112	381	17,506	191		4,062	(2)	4	4,257

Year	Herring						Mackerel					
	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total
1879	(1)	(1)	7,795	(1)	(1)		(1)	(1)	61,423	(1)	(1)	
1880	34,695	109	(1)	(1)	(1)		31,694	2,573	(1)	89	1,304	
1887	33,570	228	9,019			42,817	5,568	211	26,255	943	122	33,099
1888	40,802	358	11,371			52,531	2,087	115	16,799	647	61	19,709
1889	32,156	20	10,937			43,113	1,176	55	8,222	704	55	10,212
1890	(1)	(1)	(1)				3,514	108	6,984	339		10,945
1891	(1)	(1)	(1)				6,988	68	11,939	274	93	19,362
1892	40,814	147	12,103	1		53,065	5,072	59	16,038	227	99	21,495
1897 (fiscal)	45,667	220	10,482	(1)	(1)		2,674	91	14,385	(1)	(1)	
1898	46,596	65	19,463	2		66,126	1,661	59	7,722	360	79	9,881
1902	165,136	100	35,362			200,598	1,840	100	20,300	616	300	23,156
1905	65,926	40	19,920			85,886	917	17	15,964	838	147	17,883
1908	92,985		28,501	214		121,700	380		10,453	537	122	11,492
1919	86,979		10,811	170	3	97,963	604		13,954	1,576	91	16,225
1924	47,930		13,180	507	(2)	61,617	2,310		22,108	2,381	304	27,103
1928	64,685		5,646	221	3	70,555	1,596		37,161	2,696	1,269	42,722

Year	Menhaden						Pollock					
	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total
1879	(1)	(1)	26,066	(1)	(1)		(1)	(1)	4,754	(1)	(1)	
1880	(1)	(1)	(1)	68,694	65,092		(1)	76	(1)	(1)	20	
1887	702		543	34,035	42,049	77,329	2,684	64	3,781	102	14	6,645
1888	3,125	21	4,968	78,270	43,966	130,350	3,375	38	5,006	101	14	8,534
1889	10,185	501	2,546	112,580	47,991	173,803	4,256	7	7,046	103	17	11,429
1892	83	4	250	10,761	22,947	34,045	(1)	(1)	(1)	(1)	(1)	
1897 (fiscal)	229	20	1,106	(1)	(1)		2,378	158	7,330	(1)	(1)	
1898	7,860		1,497	3,140	11,183	23,680	3,132	183	7,601	50		10,966
1902	252		875	471	16,877	18,475	6,419	158	13,439	30	4	20,050
1905			1,027	1,026	29,731	31,784	3,363	105	25,791	291	6	29,556
1908			258	17,942	28,636	46,836	8,941	6	20,006	266	25	29,244
1919			161	21,536	6,737	28,434	5,667	26	19,293	99	10	25,095
1924	1		522	1,743	5,270	7,536	2,878	4	5,360	116	48	8,406
1928			4	1,727	3,444	5,175	2,876	5	7,701	167	290	11,039

[1] Not available. Prior to 1889 some of these species were included under "Miscellaneous fish" or "All other species."

[2] Less than 500 pounds.

Fisheries of the New England States, 1879 to 1928—Continued

CATCH OF CERTAIN SPECIES: BY STATES—Continued

[Expressed in thousands of pounds, that is, 000 omitted]

Year	Scup				Skates				
	Massachusetts	Rhode Island	Connecticut	Total	Maine	Massachusetts	Rhode Island	Connecticut	Total
1879	1,022	(1)	(1)	------	(1)	(1)	(1)	(1)	
1880	(1)	6,691	930	------	(1)	(1)	(1)	(1)	------
1887	2,322	3,030	2	5,354	------	------	------	------	------
1888	1,786	4,208	2	5,996	------	------	------	------	------
1889	2,501	6,064	7	8,572	------	------	------	------	------
1898	1,044	6,390	101	7,535	------	------	------	------	------
1902	589	6,834	396	7,819	------	------	------	------	------
1905	1,019	5,540	28	6,587	25	1	------	------	26
1908	1,136	4,616	95	5,847	------	93	------	------	93
1919	79	8,261	2	8,342	2	101	------	(2)	103
1924	158	1,192	2	1,352	------	41	14	(2)	55
1928	855	2,004	(2)	2,859	(2)	33	621	404	1,058

Year	Smelt						Swordfish					
	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total
1879	(1)	(1)	35	(1)	(1)	------	(1)	(1)	732	(1)	(1)	------
1880	(1)	(1)	(1)	95	27	------	(1)	20	(1)	90	74	------
1887	1,204	36	12	55	9	1,316	235	14	231	101	104	685
1888	1,279	36	11	62	10	1,398	442	43	264	217	181	1,147
1889	1,055	46	11	84	13	1,209	635	32	262	166	146	1,241
1892	1,617	31	3	38	9	1,698	------	(1)	------	(1)	(1)	------
1897 (fiscal)	(1)	(1)	(1)	(1)	(1)	------	985	6	490	(1)	(1)	------
1898	1,608	------	7	4	6	1,625	879	------	624	56	86	1,645
1902	1,125	------	------	11	3	1,139	643	4	750	127	166	1,690
1905	589	------	7	6	17	619	780	------	1,703	362	451	3,296
1908	654	3	16	1	10	684	513	------	1,642	308	240	2,703
1919	524	------	39	------	25	588	425	------	712	101	88	1,326
1924	627	4	38	8	11	688	863	------	1,733	206	80	2,882
1928	832	5	32	17	17	903	693	------	2,731	774	168	4,366

Year	Whiting						Crabs					
	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total
1887	------	------	45	------	2	47	------	------	------	5	83	88
1888	------	------	70	------	17	87	------	------	------	4	83	87
1889	------	------	114	------	12	126	------	------	------	5	8	13
1898	------	------	37	------	4	41	------	------	------	13	------	13
1902	92	------	2,286	104	31	2,513	------	------	------	16	------	16
1905	124	50	4,301	270	69	4,814	------	------	60	20	------	80
1908	25	------	5,589	534	179	6,327	------	------	123	146	------	269
1919	691	------	13,919	1,584	9	16,203	71	------	1,765	34	------	1,870
1924	70	------	6,307	1,744	2	8,123	171	4	1,751	50	10	1,986
1928	4	------	6,996	1,377	1	8,378	159	------	3,139	275	182	3,755

[1] Not available. Prior to 1889 some of these species were included under "Miscellaneous fish" or "All other species."
[2] Less than 500 pounds.

Fisheries of the New England States, 1879 to 1928—Continued

CATCH OF CERTAIN SPECIES: BY STATES—Continued

[Expressed in thousands of pounds, that is, 000 omitted]

Year	Lobsters						Squid				
	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total	Maine	Massachusetts	Rhode Island	Connecticut	Total
1879	(1)	(1)	4,315	(1)	(1)	------	(1)	225	(1)	(1)	------
1880	14,234	250	(1)	423	724	------	------	(1)	(1)	(1)	------
1887	22,917	143	3,511	570	1,487	28,628	------	511	------	------	------
1888	21,696	136	3,743	588	1,477	27,640	------	486	------	------	486
1889	25,002	137	3,354	456	1,501	30,450	------	568	------	------	568
1892	17,643	196	3,182	774	1,615	23,410	------	(1)	(1)	(1)	------
1897 (fiscal)	10,301	90	2,089	(1)	(1)	------	(1)	(1)	(1)	(1)	------
1898	11,183	109	1,694	578	1,098	14,662	------	1,074	124	7	1,205
1900	12,347	205	1,805	660	550	15,567	(1)	(1)	(1)	(1)	------
1902	12,163	128	1,696	397	372	14,756	------	5,365	94	38	5,497
1905	9,018	256	1,283	530	437	11,524	------	786	133	26	945
1908	9,929	264	2,455	1,425	661	14,734	6	1,837	292	21	2,156
1913	7,672	302	1,524	1,283	724	11,505	(1)	(1)	(1)	(1)	------
1919	5,546	298	2,388	1,694	741	10,677	(2)	6,135	378	4	6,517
1924	5,512	126	1,680	1,696	702	9,716	2	2,105	953	17	3,077
1928	7,100	130	2,042	1,638	694	11,604	27	5,540	2,311	49	7,927

Year	Clams, hard [3]					Clams, soft [4]					
	Maine	Massachusetts	Rhode Island	Connecticut	Total	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total
1879	(1)	88	(1)	(1)	------	(1)	(1)	1,586	(1)	(1)	------
1880	------	(1)	------	------	------	3,184	180	(1)	540	750	------
1887	1	284	154	151	590	6,088	3	2,307	258	267	8,923
1888	1	209	265	151	626	6,007	3	2,438	308	266	9,022
1889	1	135	237	171	544	8,423	3	2,518	334	264	11,542
1892	------	(5)	(5)	(5)	------	4,169	10	[6] 2,418	[6] 489	[6] 380	7,466
1898	------	510	250	234	994	9,470	6	1,471	150	200	11,297
1902	------	855	217	151	1,223	5,546	30	2,279	265	225	8,345
1905	------	1,332	182	54	1,568	3,728	28	2,175	307	138	6,376
1908	------	1,119	162	100	1,381	5,061	------	1,916	275	42	7,294
1919	------	876	156	50	1,082	2,106	67	2,187	404	229	4,993
1924	1	1,222	432	24	1,679	3,577	36	2,520	82	44	6,259
1928	------	1,661	540	31	2,232	3,621	------	1,797	14	38	5,470

Year	Oysters [7]						Scallops [8]				
	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total	Maine	Massachusetts	Rhode Island	Connecticut	Total
1879	(1)	(1)	252	(1)	(1)	------	(1)	42	(1)	(1)	------
1880	------	8	(1)	1,306	2,692	------	------	(1)	125	------	------
1887	------	------	302	1,358	11,009	12,669	221	252	11	2	486
1888	------	------	319	1,325	10,569	12,213	180	157	5	------	342
1889	------	------	259	1,424	10,401	12,084	295	117	23	3	438
1892	------	------	454	1,506	14,911	16,871	116	505	316	3	940
1897 (fiscal)	1	------	339	(1)	(1)	------	(1)	(1)	(1)	(1)	------
1898	------	------	709	3,202	14,633	18,544	167	876	115	50	1,208
1902	------	------	724	4,256	14,571	19,551	115	397	120	14	646
1905	------	------	996	6,413	25,811	33,220	415	263	2	------	680
1908	1	------	1,084	8,603	27,636	37,324	1,257	502	4	------	1,763
1910	------	------	2,026	15,878	23,690	41,594	------	(1)	(1)	(1)	------
1919	------	------	878	6,262	12,197	19,337	73	1,332	34	38	1,477
1924	------	------	698	2,584	8,020	11,302	296	699	271	2	1,268
1928	------	------	1,079	3,248	5,046	9,373	326	1,354	73	------	1,753

[1] Not available. Prior to 1889 some of these species were included under "Miscellaneous fish" or "All other species."
[2] Less than 500 pounds.
[3] Shown on the basis of 8 pounds of meat to the bushel.
[4] Shown on the basis of 10 pounds of meat to the bushel.
[5] Included with soft clams.
[6] Includes hard clams.
[7] Shown on the basis of 7 pounds of meat to the bushel.
[8] Shown on the basis of 6 pounds of meat to the bushel.

NOTE.—It is possible that in some instances since 1889 a few of the above species are not shown by reason of being included under "Miscellaneous fish" or "All other species."

Fisheries of the New England States, 1879 to 1928—Continued

SUMMARY: BY STATES

[Expressed in thousands of pounds and thousands of dollars; that is, 000 omitted]

Year	Maine		New Hampshire		Massachusetts		Rhode Island		Connecticut		Total	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
1880	---------	2,742	---------	171	---------	7,960	---------	697	---------	933	---------	12,503
1887	131,380	2,365	4,255	99	299,544	6,464	45,285	684	39,750	301	520,214	9,913
1888	132,930	2,292	3,843	90	302,046	6,356	91,687	825	42,402	297	572,908	9,860
1889	129,560	2,111	4,355	89	299,218	5,858	127,365	935	92,672	1,558	653,170	10,551
1898	123,405	2,655	3,021	49	202,258	4,464	32,854	955	31,920	1,559	393,458	9,682
1902	242,390	2,919	1,593	50	230,646	6,482	21,614	1,156	37,832	1,799	534,075	12,406
1905	124,724	2,386	1,036	52	255,655	7,025	23,896	1,547	74,973	3,174	480,284	14,184
1908	173,843	3,257	677	53	244,313	7,095	44,254	1,752	66,942	2,982	530,029	15,139
1919	147,956	3,889	529	93	246,951	10,860	48,251	3,296	23,653	1,701	467,340	19,839
1924	116,707	4,137	447	56	243,363	10,799	20,535	1,819	25,770	2,007	406,822	18,818
1928	123,326	4,231	239	45	380,169	15,649	27,666	2,398	72,198	3,297	603,598	25,620

VESSEL FISHERIES AT PRINCIPAL NEW ENGLAND PORTS

ECONOMIC ASPECT

The landings of fishery products at the principal New England ports (Boston and Gloucester, Mass., and Portland, Me.) by vessels of 5 net tons and over during 1929 amounted to 327,096,327 pounds, as landed, valued at $13,051,704. This exceeded the amount landed and value of the landings for any year for which records are available. Increased landings are due to the larger landings of haddock, mackerel, and hake. Of the total landings, 99 per cent consisted of fresh fish and 1 per cent of salt fish. The landings at Boston accounted for the bulk of those landed at the three ports in 1929, amounting to 255,721,954 pounds, valued at $10,736,653, or 78 per cent of the total. This is an increase over 1928 of 17 per cent in amount and 22 per cent in value. Landings at Gloucester in 1929 amounted to 53,879,975 pounds, valued at $1,708,596, or 17 per cent of the total. This is an increase of 29 per cent in amount and 16 per cent in value compared with the amount and value of the landings in 1928. At Portland, 17,494,398 pounds of fishery products, valued at $606,455, were landed. This was 5 per cent of the total landings at the three ports, and a decrease of 1 per cent in amount and an increase of 7 per cent in value compared with the landings in 1928.

Species landed.—Among the landings of fresh fish, haddock far outranked other species in volume landed, the amount of all sizes in 1929 being 187,203,733 pounds, or 58 per cent of the total fresh fish. This is an increase of 21 per cent over the amount landed in 1928. Of the total haddock landed, 58 per cent were taken from Georges Bank, 34 per cent from South Channel, 5 per cent from Browns Bank, and the remainder (except for 3,117,170 pounds which were taken off Canada) were taken from various other banks off the United States.

Cod was of next importance, although a very poor second. The landings of all sizes of this species fresh amounted to 49,522,884 pounds, or 15 per cent of the total amount of fresh fish landed at the three ports in 1929. This is a decrease of 15 per cent from that landed in 1928. Cod was taken chiefly on Georges Bank and South Channel.

Mackerel landings, fresh, amounted to 37,521,563 pounds at the three ports, or 12 per cent of the total landings of fresh fish. This is 81 per cent of the total catch of mackerel by the United States Atlantic mackerel fleet, and an increase of 55 per cent compared with the landings of this species in 1928.

Hake, with landings of 12,037,034 pounds, or 4 per cent of the total fresh-fish landings ranked fourth in importance, and increased 43 per cent over the landings of the previous year.

Flounders, a species which has been of increasing importance in the trade during the last few years, ranked fifth in importance among the fresh fish with landings of 10,787,765 pounds, or about 3 per cent of the total landings of all fresh fish. This is an increase of 4 per cent over 1928.

Pollock, with landings of 10,561,970 pounds, or 3 per cent of the total landings of fresh fish in 1929, ranked sixth in importance, and increased 32 per cent over the previous year.

The landings of all other varieties of fresh fish, amounting to about 5 per cent of the total, increased in 1929 over the respective amount of the landings in 1928 except halibut.

Among the salt fish, herring was the most important species, with landings of 3,518,160 pounds. This was 72 per cent of the landings of all salt fish, and was an increase of 149 per cent compared with the landings of this species in 1928.

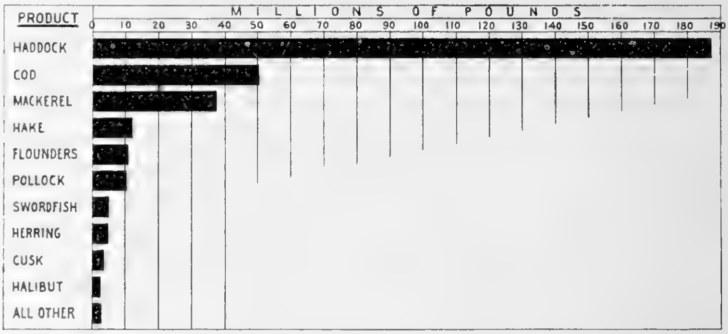

FIGURE 15.—Landings of fish by fishing vessels at the principal New England ports, 1929

The landings of salt ground fish—cod, hake, pollock, cusk, and halibut—amounted to 1,153,362 pounds, and consisted almost entirely of salt cod. This amount was 24 per cent of the total landings of salt fish at the three ports. The landings of the various species of salt ground fish landed in 1929 varied but little from the amount landed in 1928.

Landings of salt mackerel amounted to 221,945 pounds, which was 4 per cent of the total landings of salt fish, and was an increase of 152 per cent compared with the landings of this species salted in 1928.

Fishery by months.—Over 50 per cent of the landings of fish at the three ports were made during the five months from July to October, inclusive. The total landings during the month of July were largest and amounted to 38,200,136 pounds. Landings during September were second largest, amounting to 37,494,064 pounds; and those during August were third largest, amounting to 36,141,458 pounds. As a rule, landings during each of the warmer months were larger than during the cooler months of the year.

The following table gives the economic statistics obtained on the landings of fishery products at Boston, Gloucester, and Portland during 1929, for vessels of 5 net tons and upward, as measured by the United States Customs Service. The weights of fresh and salted fish given in this table represent the weights as landed from the vessels. Many of the fresh fish landed were eviscerated on the vessels. This is true of the ground fish group, except the flounders. Swordfish are eviscerated and beheaded. Fresh mackerel, flounders, and herring are landed in the round. Species included under "other" are generally landed in the round. Salted ground fish are landed eviscerated and beheaded; salted mackerel eviscerated and split; and salted herring, gibbed. The values are those received by the fisherman. The grades, or sizes given for certain species, are those recognized in the trade.

Landings by fishing vessels at principal New England ports, 1929

BOSTON: BY MONTHS

Species	January		February		March	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod, fresh:						
Large	1, 068, 767	$82, 804	3, 138, 741	$128, 429	3, 377, 701	$122, 706
Market	505, 145	24, 785	759, 255	29, 480	620, 606	20, 066
Scrod	4, 875	161	2, 910	58	120	4
Haddock, fresh:						
Large	9, 595, 915	594, 645	13, 556, 265	674, 673	15, 131, 720	618, 874
Scrod	670, 865	27, 754	793, 960	28, 825	858, 000	24, 796
Hake, fresh:						
Large	456, 230	26, 583	406, 115	23, 218	211, 100	12, 205
Small			1, 000	20	420	17
Pollock, fresh	336, 890	17, 965	590, 960	18, 685	209, 670	9, 432
Cusk, fresh	159, 660	6, 373	240, 140	9, 764	170, 745	5, 239
Halibut, fresh	18, 148	7, 338	249, 877	52, 696	242, 928	41, 021
Flounders, fresh	453, 257	54, 131	768, 933	50, 451	675, 230	47, 871
Other, fresh	69, 895	5, 672	192, 409	6, 906	115, 723	5, 643
Total, fresh	13, 339, 647	848, 211	20, 700, 565	1, 023, 205	21, 613, 963	907, 874
Landed in 1928: Total, Fresh	12, 578, 924	688, 195	15, 708, 584	904, 209	22, 845, 734	949, 393

BOSTON: BY MONTHS

Species	April		May		June		July	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod, fresh:								
Large	2, 029, 564	$83, 434	1, 432, 260	$51, 293	1, 701, 208	$66, 817	2, 337, 643	$90, 570
Market	736, 845	21, 795	985, 695	20, 371	1, 400, 475	31, 056	2, 856, 845	62, 637
Scrod	7, 190	75	1, 500	15	9, 795	98	5, 735	60
Cod, salted:								
Large			20, 620	1, 131	15, 000	750		
Market			450	18	400	16		
Haddock, fresh:								
Large	13, 437, 633	350, 990	12, 514, 479	279, 407	11, 205, 358	286, 369	14, 728, 871	300, 165
Scrod	800, 035	13, 161	717, 980	8, 024	816, 172	11, 094	853, 935	9, 212
Hake, fresh, large	180, 591	9, 694	297, 890	7, 276	285, 520	5, 091	457, 340	6, 911
Pollock, fresh	120, 420	6, 882	81, 680	1, 835	150, 497	3, 319	261, 285	6, 586
Pollock, salted							110	2
Cusk, fresh	126, 785	3, 545	281, 485	5, 147	33, 450	623	66, 430	1, 104
Halibut, fresh	274, 057	46, 361	293, 070	56, 728	409, 996	62, 292	394, 160	60, 394
Mackerel, fresh	40, 000	4, 100	668, 640	34, 216	4, 868, 965	204, 197	5, 467, 140	226, 198
Mackerel, salted							3, 500	178
Flounders, fresh	1, 112, 280	35, 464	1, 106, 086	17, 400	728, 904	15, 511	589, 497	24, 854
Swordfish, fresh					610, 294	134, 051	2, 241, 936	344, 768
Herring, fresh					3, 750	62		
Other, fresh	156, 260	4, 760	114, 359	3, 875	73, 396	3, 401	89, 638	4, 944
Total, fresh	19, 021, 660	580, 261	18, 495, 124	485, 587	22, 297, 780	823, 981	30, 350, 455	1, 138, 403
Total, salted			21, 070	1, 149	15, 400	766	3, 610	180
Grand total	19, 021. 660	580, 261	18, 516, 194	486, 736	22, 313, 180	824, 747	30, 354, 065	1, 138, 583
Landed in 1928:								
Fresh	17, 727, 360	542, 113	16, 190, 192	463, 272	18, 653, 239	666, 089	20, 214, 452	831, 627
Salted							8, 625	149
Total	17, 727, 360	542, 113	16, 190, 192	463, 272	8, 653, 239 1	666, 089	20, 223, 077	831, 776

NOTE.—The weights of fresh and salted fish given in these statistics represent the fish as landed from the vessels, and the values are those received by the fishermen. Large cod are classified as those weighing over 10 pounds; market cod, 2½ to 10 pounds; and scrod cod, 1 to 2½ pounds. Large haddock are those weighing over 2½ pounds and scrod haddock, 1 to 2½ pounds. Large hake are those weighing over 6 pounds and small hake, under 6 pounds.

Landings by fishing vessels at principal New England ports, 1929—Continued

BOSTON: By months—Continued

Species	August		September		October		November	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod, fresh:								
Large	2,157,718	$87,572	1,674,662	$92,489	1,944,967	$107,266	1,307,990	$68,272
Market	2,903,183	66,859	2,067,010	58,981	1,437,265	51,210	801,882	27,943
Scrod	8,390	93	20,200	390	42,115	841	63,525	1,449
Haddock, fresh:								
Large	16,431,749	431,900	14,555,285	521,560	12,188,704	638,148	9,515,215	511,211
Scrod	811,615	9,855	948,475	19,538	851,420	29,550	464,470	15,881
Hake, fresh:								
Large	642,520	10,325	848,715	16,725	2,118,230	64,016	2,837,630	89,100
Small					750	15	5,052	87
Pollock, fresh	476,375	8,403	528,870	9,771	544,075	10,557	745,775	12,628
Cusk, fresh	29,685	559	98,020	1,954	271,040	6,943	621,345	14,345
Halibut, fresh	322,002	55,637	149,765	31,137	109,510	27,772	32,641	9,547
Mackerel, fresh	3,473,667	183,391	4,014,789	100,817	2,610,911	147,555	57,720	7,649
Mackerel, salted			56,300	3,499	2,400	156		
Flounders, fresh	592,763	31,139	816,548	43,157	834,403	48,815	998,863	50,165
Swordfish, fresh	1,000,895	195,002	223,930	55,346	19,030	6,252		
Other, fresh	77,935	4,985	83,193	5,571	85,276	5,257	74,260	4,240
Total, fresh	28,928,497	1,085,720	26,029,462	957,436	23,057,696	1,144,197	17,526,368	812,517
Total, salted			56,300	3,499	2,400	156		
Grand total	28,928,497	1,085,720	26,085,762	960,935	23,060,096	1,144,353	17,526,368	812,517
Landed in 1928:								
Fresh	19,813,280	800,281	17,335,989	752,686	24,474,064	794,523	16,033,510	773,307
Salted	19,600	1,266			6,000	180		
Total	19,832,880	801,547	17,335,989	752,686	24,480,064	794,703	16,033,510	773,307

Species	December		Total, 1929		1928	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod, fresh:						
Large	747,654	$69,193	22,918,875	$1,050,845	25,091,098	$1,114,068
Market	628,475	35,463	15,702,681	450,646	14,780,884	390,149
Scrod	54,855	1,812	221,210	5,056	82,126	1,723
Cod, salted:						
Large			35,620	1,881	1,865	37
Market			850	34		
Haddock, fresh:						
Large	8,725,928	586,499	151,587,122	5,794,441	124,787,089	4,299,361
Scrod	525,435	24,074	9,112,362	221,764	12,052,193	274,608
Hake, fresh:						
Large	1,416,725	79,805	10,158,606	350,949	6,501,623	180,525
Small	830	12	8,052	151	81,645	1,323
Hake, salted, large					6,760	112
Pollock, fresh	406,575	16,075	4,453,072	122,138	3,087,336	83,649
Pollock, salted			110	2		
Cusk, fresh	604,005	25,772	2,702,790	81,368	1,573,247	43,469
Halibut, fresh	24,352	8,923	2,520,506	459,846	3,316,262	597,042
Mackerel, fresh	200	34	21,202,032	908,157	15,285,061	872,911
Mackerel, salted			62,200	3,833	19,600	1,266
Flounders, fresh	1,028,750	71,401	9,705,514	490,359	8,582,866	400,754
Swordfish, fresh			4,096,085	735,419	2,263,770	497,861
Herring, fresh			3,750	62	19,400	270
Herring, salted					6,000	180
Other, fresh	98,173	4,448	1,230,517	59,702	848,864	46,856
Total, fresh	14,261,957	923,511	255,623,174	10,730,903	218,353,464	8,804,569
Total, salted			98,780	5,750	34,225	1,595
Grand total	14,261,957	923,511	255,721,954	10,736,653	218,387,689	8,806,164
Landed in 1928:						
Fresh	16,778,136	638,874			218,353,464	8,804,569
Salted					34,225	1,595
Total	16,778,136	638,874			218,387,689	8,806,164

Landings by fishing vessels at principal New England ports, 1929—Continued

GLOUCESTER: BY MONTHS

Species	January		February		March		April	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod, fresh:								
Large	333,745	$30,051	483,245	$23,968	1,101,545	$44,103	1,123,975	$43,863
Market	13,405	798	39,960	1,716	35,595	1,082	106,900	2,273
Scrod	395	19	345	5			12,300	246
Cod, salted:								
Large					16,550	628	32,045	1,475
Market					760	23	4,405	158
Haddock, fresh:								
Large	793,355	50,696	1,219,970	58,813	1,673,145	61,708	3,491,610	60,265
Scrod	68,925	2,789	140,855	4,270	70,180	1,854	153,905	1,867
Hake, fresh:								
Large	2,875	165	15,630	545	2,030	69	3,785	59
Small	5,250	197	380	8				
Hake, salted: Large							155	4
Pollock, fresh	565	25	3,900	109	10,310	406	42,150	1,123
Cusk, fresh	90	4	230	8	4,060	56	12,290	166
Halibut, fresh	110	26	691	139	645	102	217	33
Flounders, fresh	117,091	10,408	71,620	5,396	79,550	6,241	42,230	1,570
Herring, salted	1,857,832	70,671	452,856	17,196				
Other, fresh			5,820	98	3,420	97	1,145	24
Total, fresh	1,335,806	95,178	1,982,646	95,075	2,980,480	115,718	4,990,507	111,489
Total, salted	1,857,832	70,671	452,856	17,196	17,310	651	36,605	1,637
Grand total	3,193,638	165,849	2,435,502	112,271	2,997,790	116,369	5,027,112	113,126
Landed in 1928:								
Fresh	737,570	45,227	808,620	52,864	1,968,565	98,828	3,280,020	93,580
Salted	787,140	30,271			2,550	126	27,404	1,373
Total	1,524,710	75,498	808,620	52,864	1,971,115	98,954	3,307,424	94,953

Species	May		June		July	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod, fresh:						
Large	1,274,116	$46,209	1,125,420	$30,503	504,130	$13,577
Market	105,335	2,027	520,215	11,180	420,580	9,091
Scrod			275	3		
Cod, salted:						
Large	174,290	8,051	325,390	13,874	97,005	4,762
Market	18,850	687	88,305	2,514	14,465	533
Haddock, fresh:						
Large	2,023,785	45,365	1,861,555	43,381	1,767,185	35,320
Scrod	126,880	1,325	116,930	1,295	123,365	962
Hake, fresh: Large	25,625	321	35,860	536	34,016	417
Hake, salted: Large	3,075	77			460	9
Pollock, fresh	273,462	5,921	5,990	86	7,290	93
Pollock, salted			215	5	420	9
Cusk, fresh	43,055	699	26,255	428	19,090	289
Cusk, salted	400	10	700	50	600	21
Halibut, fresh	974	117	697	105	21,002	1,448
Halibut, salted	25	2			435	44
Mackerel, fresh	81,600	5,740	1,078,082	39,900	2,788,485	74,517
Mackerel, salted			24,200	1,540	8,000	520
Flounders, fresh	93,105	2,249	36,250	804	33,570	984
Swordfish, fresh			709	128	7,690	1,218
Herring, fresh					58,600	733
Other, fresh	760	17	790	21	59,150	1,174
Total, fresh	4,048,697	109,990	4,809,028	128,370	5,844,153	139,823
Total, salted	196,640	8,827	438,810	17,953	121,385	5,898
Grand total	4,245,337	118,817	5,247,838	146,323	5,965,538	145,721
Landed in 1928:						
Fresh	4,477,905	114,939	5,771,710	167,335	5,902,870	166,015
Salted	232,165	11,642	202,805	9,986	150,215	7,193
Total	4,710,070	126,581	5,974,515	177,321	6,053,085	173,208

Landings by fishing vessels at principal New England ports, 1929—Continued

GLOUCESTER: BY MONTHS—Continued

Species	August		September		October		November	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod, fresh:								
Large	228,860	$6,542	560,090	$29,358	130,126	$7,972	66,290	$4,080
Market	186,555	4,308	80,085	1,865	23,095	787	28,725	911
Scrod	100	1						
Cod, salted:								
Large	149,070	7,372	74,160	3,921	35,300	1,804		
Market	14,925	625	10,430	451	2,632	106		
Haddock, fresh:								
Large	1,312,720	33,883	1,089,800	37,811	769,140	40,424	1,005,235	52,881
Scrod	67,770	759	129,235	2,450	72,985	2,295	78,135	2,249
Hake, fresh: Large	40,685	543	89,690	1,369	111,425	3,504	126,095	3,788
Hake, salted:								
Large	2,565	59	580	12	4,605	106		
Small					920	23		
Pollock, fresh	29,445	408	93,000	2,053	348,865	7,283	2,746,087	36,037
Pollock, salted	1,670	34	210	5	280	6		
Cusk, fresh	64,925	1,108	34,460	527	9,495	166	465	10
Cusk, salted	3,330	88			4,440	145		
Halibut, fresh	20,229	1,530	567	64	570	106	740	131
Mackerel, fresh	3,024,670	76,611	6,589,945	136,680	398,199	25,716	373,821	50,676
Mackerel, salted	45,460	1,375	65,200	3,821			350	53
Flounders, fresh	21,440	795	25,715	1,193	15,790	1,025	31,405	1,969
Swordfish, fresh	602	120	2,180	458				
Herring, fresh	13,000	130	8,000	50				
Other, fresh	112,960	1,366	114,010	1,339	18,575	819	160,652	11,140
Total, fresh	5,123,961	128,104	8,816,777	215,217	1,898,265	90,097	4,617,650	163,872
Total, salted	217,020	9,553	150,580	8,210	48,177	2,190	350	53
Grand total	5,340,981	137,657	8,967,357	223,427	1,946,442	92,287	4,618,000	163,925
Landed in 1928:								
Fresh	3,731,916	113,660	2,475,295	100,212	3,651,282	111,390	3,862,636	193,058
Salted	237,498	13,294	153,350	8,661	54,925	2,829	15,007	779
Total	3,969,414	126,954	2,628,645	108,873	3,706,207	114,219	3,877,643	193,837

Species	December		Total, 1929		1928	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod, fresh:						
Large	196,028	$22,054	7,127,570	$302,280	12,326,926	$459,872
Market	14,077	634	1,574,527	36,672	2,761,885	56,538
Scrod			13,415	274	7,790	89
Cod, salted:						
Large			903,810	41,887	853,392	45,262
Market			154,772	5,097	140,012	5,633
Scrod					400	11
Haddock, fresh:						
Large	631,317	41,654	17,638,817	562,201	8,904,022	209,910
Scrod	75,765	2,473	1,224,930	24,588	746,495	12,481
Haddock, salted:						
Large					8,170	425
Scrod					70	2
Hake, fresh:						
Large	72,038	3,864	559,754	15,180	384,578	7,000
Small			5,630	205	3,730	61
Hake, salted:						
Large			11,440	267	2,320	45
Small			920	23	840	17
Pollock, fresh	1,596,947	50,384	5,158,011	103,928	4,083,175	75,813
Pollock, salted			2,795	59	8,590	174
Cusk, fresh	260	7	214,675	3,468	298,000	4,695
Cusk, salted			9,470	284	6,515	139
Halibut, fresh	181	46	46,623	3,847	908	214
Halibut, salted			460	46	3,520	314
Mackerel, fresh	1,760	352	14,336,562	410,192	8,144,450	442,026
Mackerel, salted			143,210	7,309	68,150	4,802
Flounders, fresh	96,800	5,649	664,566	38,283	1,322,207	89,846
Swordfish, fresh			11,181	1,924	18,340	3,981
Herring, fresh			79,600	913	252,800	2,703
Herring, salted	1,207,472	45,619	3,518,160	133,516	1,404,564	53,289
Other, fresh	1,795	58	479,077	16,153	151,984	2,358
Total, fresh	2,686,968	127,175	49,134,938	1,520,108	39,407,290	1,367,587
Total, salted	1,207,472	45,649	4,745,037	188,488	2,496,543	110,113
Grand total	3,894,440	172,824	53,879,975	1,708,596	41,903,833	1,477,700
Landed in 1928:						
Fresh	2,738,901	110,479			39,407,290	1,367,587
Salted	633,484	23,959			2,496,543	110,113
Total	3,372,385	134,438			41,903,833	1,477,700

Landings by fishing vessels at principal New England ports, 1929—Continued

PORTLAND: BY MONTHS

Species	January		February		March	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod, fresh:						
Large	56,891	$4,105	73,171	$3,309	76,157	$3,243
Market	24,554	1,291	34,740	1,451	40,195	1,533
Scrod	2,355	25	3,061	31	1,830	16
Haddock, fresh:						
Large	223,936	17,772	946,756	41,151	760,196	26,895
Scrod	7,305	86	11,110	111	12,435	120
Hake, fresh:						
Large	2,508	185	1,327	66	100	4
Small	68,610	3,646	60,979	2,880	31,424	1,267
Pollock, fresh	32,882	1,488	33,840	786	47,661	1,668
Cusk, fresh	52,253	2,921	55,932	2,512	70,646	2,496
Halibut, fresh	759	208	903	199	1,847	274
Flounders, fresh	38,118	2,793	67,518	3,116	56,997	2,151
Other, fresh	29,049	731	51,462	1,311	40,794	955
Total, fresh	539,220	35,251	1,340,799	56,923	1,140,282	40,622
Landed in 1928:						
Fresh	579,643	31,853	734,185	38,696	1,229,213	47,425
Salted	----	----	1,125	17	100	1
Total	579,643	31,853	735,310	38,713	1,229,313	47,426

Species	April		May		June		July	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod, fresh:								
Large	274,306	$7,333	143,100	$4,151	128,175	$5,656	171,163	$7,747
Market	46,320	1,211	20,995	483	3,965	85	5,796	133
Scrod	1,715	10	295	2	655	2	925	9
Cod, salted:								
Large	----	----	8,300	398	14,700	699	1,290	58
Market	----	----	850	33	2,695	101	870	30
Haddock, fresh:								
Large	1,971,600	36,419	524,733	9,751	186,030	4,974	884,675	19,684
Scrod	3,605	31	1,070	8	3,040	20	4,335	29
Hake, fresh:								
Large	1,500	45	1,130	62	435	5	1,470	23
Small	20,306	940	45,145	924	37,510	536	53,253	792
Hake, salted:								
Large	----	----	880	18	----	----	----	----
Small	----	----	110	3	1,020	18	----	----
Pollock, fresh	10,080	193	18,730	255	109,390	1,486	52,854	905
Cusk, fresh	72,130	1,886	40,539	769	2,837	62	1,625	33
Cusk, salted	----	----	1,000	25	1,300	32	----	----
Halibut, fresh	4,404	875	10,787	1,882	67,329	10,927	37,903	5,569
Mackerel, fresh	----	----	5,795	189	6,691	375	297,387	12,295
Mackerel, salted	----	----	1,100	16	----	----	85	4
Flounders, fresh	69,580	1,549	39,885	805	34,275	670	37,005	833
Swordfish, fresh	----	----	----	----	46,139	9,575	271,167	41,281
Herring, fresh	----	----	----	----	290,700	4,588	13,600	238
Other, fresh	32,378	582	12,974	252	15,700	313	45,130	1,476
Total, fresh	2,507,924	51,074	865,178	19,533	932,871	39,274	1,878,288	91,047
Total, salted	----	----	12,240	493	19,715	850	2,245	92
Grand total	2,507,924	51,074	877,418	20,026	952,586	40,124	1,880,533	91,139
Landed in 1928:								
Fresh	1,357,163	26,923	3,176,750	61,516	1,981,332	44,218	1,553,676	59,577
Salted	116,000	1,710	24,670	1,184	1,645	81	----	----
Total	1,473,163	28,633	3,201,420	62,700	1,982,977	44,299	1,553,676	59,577

Species	August		September		October		November	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod, fresh:								
Large	99,306	$4,883	123,152	$6,759	199,809	$12,783	191,420	$9,913
Market	8,368	206	18,049	483	31,698	890	40,135	1,057
Scrod	1,485	7	5,580	31	5,019	37	8,105	49
Haddock, fresh:								
Large	1,007,981	23,064	222,245	10,235	316,124	19,145	313,668	16,835
Scrod	4,953	34	6,440	45	17,791	138	18,134	172
Hake, fresh:								
Large	1,140	19	4,940	95	----	----	4,385	131
Small	63,649	1,031	154,935	3,183	345,390	9,173	286,563	7,906
Pollock, fresh	41,625	693	95,600	1,405	233,114	3,995	238,749	3,510
Cusk, fresh	3,268	67	17,988	378	56,948	1,670	128,915	2,706
Halibut, fresh	511	78	805	127	868	167	2,005	459
Mackerel, fresh	191,580	7,310	1,338,337	28,869	143,179	3,494	----	----

Landings by fishing vessels at principal New England ports, 1929—Continued

PORTLAND: BY MONTHS—Continued

Species	August		September		October		November	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Mackerel, salted	15,350	$314						
Flounders, fresh	21,277	780	6,297	$357	7,019	$542	21,501	$754
Swordfish, fresh	109,621	19,729	58,769	12,815				
Herring, fresh	21,000	368	75,400	566	209,000	1,296	279,400	1,596
Other, fresh	280,866	5,032	312,408	5,200	134,210	2,316	73,987	1,503
Total, fresh	1,856,630	63,301	2,440,945	70,548	1,700,169	55,646	1,606,967	46,591
Total, salted	15,350	314						
Grand total	1,871,980	63,615	2,440,945	70,548	1,700,169	55,646	1,606,967	46,591
Landed in 1928:								
Fresh	1,696,452	79,329	1,095,616	41,604	1,732,195	47,625	1,258,600	43,736
Salted	10,240	457	387	31				
Total	1,706,692	79,786	1,096,003	41,635	1,732,195	47,625	1,258,600	43,736

Species	December		Total, 1929		1928	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod, fresh:						
Large	84,843	$6,955	1,621,493	$76,837	2,673,201	$108,792
Market	30,312	1,534	305,127	10,357	377,401	12,711
Scrod	6,961	71	37,986	290	53,500	411
Cod, salted:						
Large			24,290	1,155	146,525	3,217
Market			4,415	164	5,105	197
Haddock, fresh:						
Large	186,751	15,487	7,544,695	241,412	8,722,779	238,886
Scrod	5,589	56	95,807	850	109,647	810
Hake, fresh:						
Large	130	6	19,065	641	33,062	789
Small	118,163	5,320	1,285,927	37,598	1,406,925	31,787
Hake, salted:						
Large			880	18		
Small			1,130	21	1,385	22
Pollock, fresh	36,362	1,025	950,887	17,409	861,319	14,794
Pollock, salted					45	1
Cusk, fresh	50,424	2,268	553,505	17,768	479,205	14,424
Cusk, salted	100	1	2,400	58	720	13
Halibut, fresh	138	39	128,259	20,804	64,789	11,410
Mackerel, fresh			1,982,969	52,532	735,249	34,882
Mackerel, salted			16,535	334	387	31
Flounders, fresh	18,213	1,011	417,685	15,361	508,947	20,696
Swordfish, fresh			485,696	83,400	261,530	52,829
Herring, fresh	65,400	456	954,500	9,108	433,600	2,336
Other, fresh	32,189	667	1,061,147	20,338	814,848	16,243
Total, fresh	635,475	34,895	17,444,748	604,705	17,536,002	561,800
Total, salted	100	1	49,650	1,750	154,167	3,481
Grand total	635,575	34,896	17,494,398	606,455	17,690,169	565,281
Landed in 1928:						
Fresh	1,141,177	39,298			17,536,002	561,800
Salted					154,167	3,481
Total	1,141,177	39,298			17,690,169	565,281

SUMMARY: BY PORTS

Species	Boston		Gloucester		Portland	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod, fresh:						
Large	22,918,875	$1,050,845	7,127,570	$302,280	1,621,493	$76,837
Market	15,702,681	450,646	1,574,527	36,672	305,127	10,357
Scrod	221,210	5,056	13,415	274	37,986	290
Cod, salted:						
Large	35,620	1,881	903,810	41,887	24,290	1,155
Market	850	34	154,772	5,097	4,415	164
Haddock, fresh:						
Large	151,587,122	5,794,441	17,638,817	562,201	7,544,695	241,412
Scrod	9,112,362	221,764	1,224,930	24,588	95,807	850
Hake, fresh:						
Large	10,158,606	350,949	559,754	15,180	19,065	641
Small	8,052	151	5,630	205	1,285,927	37,598
Hake, salted:						
Large			11,440	267	880	18
Small			920	23	1,130	21

Landings by fishing vessels at principal New England ports, 1929—Continued

SUMMARY: BY PORTS—Continued

Species	Boston		Gloucester		Portland	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Pollock, fresh	4,453,072	$122,138	5,158,011	$103,928	950,887	$17,409
Pollock, salted	110	2	2,795	59	----	----
Cusk, fresh	2,702,790	81,368	214,675	3,468	553,505	17,768
Cusk, salted	----	----	9,470	284	2,400	58
Halibut, fresh	2,520,506	459,846	46,623	3,847	128,259	20,804
Halibut, salted	----	----	460	46	----	----
Mackerel, fresh	21,202,032	908,157	14,336,562	410,192	1,982,969	52,532
Mackerel, salted	62,200	3,833	143,210	7,309	16,535	334
Flounders, fresh	9,705,514	490,359	664,566	38,283	417,685	15,361
Swordfish, fresh	4,096,085	735,419	11,181	1,924	485,696	83,400
Herring, fresh	3,750	62	79,600	913	954,500	9,108
Herring, salted	----	----	3,518,160	133,516	----	----
Other, fresh	1,230,517	59,702	479,077	16,153	1,061,147	20,338
Total, fresh	255,623,174	10,730,903	49,134,938	1,520,108	17,444,748	604,705
Total, salted	98,780	5,750	4,745,037	188,488	49,650	1,750
Grand total	255,721,954	10,736,653	53,879,975	1,708,596	17,494,398	606,455
Landed in 1928:						
Fresh	218,353,464	8,804,569	39,407,290	1,367,587	17,536,002	561,800
Salted	34,225	1,595	2,496,543	110,113	154,167	3,481
Total	218,387,689	8,806,164	41,903,833	1,477,700	17,690,169	565,281

Species	Total, 1929		1928	
	Pounds	*Value*	*Pounds*	*Value*
Cod, fresh:				
Large	31,667,938	$1,429,962	40,091,225	$1,682,732
Market	17,582,335	497,675	17,920,170	459,398
Scrod	272,611	5,620	143,416	2,223
Cod, salted:				
Large	963,720	44,923	1,001,782	48,516
Market	160,037	5,295	145,117	5,830
Scrod	----	----	400	11
Haddock, fresh:				
Large	176,770,634	6,598,054	142,413,890	4,748,157
Scrod	10,433,099	247,202	12,908,335	287,899
Haddock, salted:				
Large	----	----	8,170	425
Scrod	----	----	70	2
Hake, fresh:				
Large	10,737,425	366,770	6,919,263	188,314
Small	1,299,609	37,954	1,492,300	33,171
Hake, salted:				
Large	12,320	285	9,080	157
Small	2,050	44	2,225	39
Pollock, fresh	10,561,970	243,475	8,031,830	174,256
Pollock, salted	2,905	61	8,635	175
Cusk, fresh	3,470,970	102,604	2,350,452	62,588
Cusk, salted	11,870	342	7,235	152
Halibut, fresh	2,695,388	484,497	3,381,959	608,666
Halibut, salted	460	46	3,520	314
Mackerel, fresh	37,521,563	1,370,881	24,164,760	1,349,819
Mackerel, salted	221,945	11,476	88,137	6,099
Flounders, fresh	10,787,765	544,003	10,414,020	511,296
Swordfish, fresh	4,592,962	820,743	2,543,640	554,671
Herring, fresh	1,037,850	10,083	705,800	5,309
Herring, salted	3,518,160	133,516	1,410,564	53,469
Other, fresh	[1] 2,770,741	96,193	1,815,696	65,457
Total, fresh	322,202,860	12,855,716	275,296,756	10,733,956
Total, salted	4,893,467	195,988	2,684,935	115,189
Grand total	327,096,327	13,051,704	277,981,691	10,849,145
Landed in 1928:				
Fresh	----	----	275,296,756	10,733,956
Salted	----	----	2,684,935	115,189
Total	----	----	277,981,691	10,849,145

[1] The items under "Other" include bluebacks, 852,713 pounds, value $13,133; butterfish, 97,960 pounds, value $9,239; eels, 1,977 pounds, value $113; "perch" or cunner, 1,680 pounds, value $86; rosefish, 46,990 pounds, value $847; salmon, 100 pounds, value $4; sea robin, 400 pounds, value $8; shad, 212,976 pounds, value $11,850; shark, 29,029 pounds, value $855; shrimp, 42 pounds, value $3; skates, 40,045 pounds, value $633; sturgeon, 3,083 pounds, value $502; whiting, 12,765 pounds, value $462; wolffish, 948,613 pounds, value $39,567; lobsters, 9 pounds, value $4; scallops, 6,796 pounds, value $1,263; livers, 369,862 pounds, value $7,385; spawn, 145,401 pounds, value $10,233; and tongues, 300 pounds, value $6.

Landings by fishing vessels at Boston, Gloucester, and Portland, 1893 to 1929

[Expressed in thousands of pounds; that is, 000 omitted]

BY SPECIES

Year	Cod		Haddock		Hake		Pollock	
	Fresh	Salted	Fresh	Salted	Fresh	Salted	Fresh	Salted
1893	20,254	34,373	33,865	44	19,754	238	3,453	161
1894	27,762	35,829	45,608	4	23,305	39	2,175	6
1895	24,071	43,228	41,578	28	15,176	165	2,356	122
1896	25,448	34,040	30,167	----------	10,526	18	1,908	255
1897	27,238	25,757	30,978	----------	14,679	18	1,891	----------
1898	31,674	26,485	32,482	37	17,502	19	4,464	20
1899	48,294	36,906	33,291	15	16,657	53	7,343	144
1900	34,051	29,969	33,043	6	11,445	78	5,278	41
1901	35,972	29,719	28,930	46	11,121	148	7,345	98
1902	36,373	30,248	38,395	2	14,264	134	12,580	16
1903	30,557	27,195	40,339	4	14,769	78	11,290	154
1904	30,636	21,443	47,509	532	21,887	237	10,521	637
1905	36,137	17,852	65,897	423	22,781	457	20,409	1,646
1906	36,196	18,323	61,195	400	13,027	260	8,522	988
1907	45,953	15,368	41,815	463	19,580	214	20,428	776
1908	41,615	21,832	47,418	641	20,434	122	12,429	1,090
1909	38,590	32,744	42,401	425	13,163	113	12,502	1,381
1910	35,549	25,790	49,227	340	19,759	189	18,808	816
1911	33,977	19,729	55,711	464	18,097	355	14,747	879
1912	35,519	18,186	63,225	323	15,289	270	14,359	307
1913	29,177	15,688	53,436	237	13,740	345	15,031	236
1914	36,080	11,450	57,599	155	12,531	222	12,243	211
1915	34,088	10,968	57,813	131	14,589	301	12,961	235
1916	35,993	7,629	60,371	184	13,029	143	15,502	101
1917	49,873	6,574	53,395	160	7,839	75	14,467	40
1918	68,338	3,487	66,603	68	5,246	35	26,507	53
1919	60,651	4,723	82,561	155	4,300	40	18,696	56
1920	58,407	3,858	75,235	45	4,666	55	8,539	22
1921	48,106	5,409	67,397	15	4,494	42	6,893	52
1922	50,174	5,006	70,065	131	5,341	33	5,048	49
1923	58,232	4,443	73,718	44	6,315	22	4,766	39
1924	58,656	2,793	79,897	5	7,263	22	5,067	18
1925	64,097	3,153	91,861	25	5,789	17	5,243	47
1926	73,637	4,582	93,983	77	5,482	23	6,705	34
1927	61,367	1,987	128,543	50	5,845	17	7,652	11
1928	58,155	1,147	155,322	8	8,411	11	8,032	9
1929	49,523	1,124	187,204	----------	12,037	14	10,562	3

Year	Cusk		Halibut		Mackerel		Flounders
	Fresh	Salted	Fresh	Salted	Fresh	Salted	Fresh
1893	9,110	174	7,964	1,829	552	8,744	----------
1894	10,454	191	9,378	1,527	936	7,077	----------
1895	5,566	255	8,660	1,062	553	4,033	----------
1896	3,322	305	9,689	1,207	1,136	10,484	----------
1897	3,049	144	8,329	1,572	1,146	1,784	----------
1898	4,918	107	8,381	1,997	874	2,222	----------
1899	3,411	228	8,236	789	1,230	3,862	----------
1900	2,018	131	7,275	1,569	8,889	15,966	----------
1901	2,029	52	5,065	463	2,783	12,013	----------
1902	1,785	21	6,326	753	2,772	8,139	----------
1903	2,881	78	3,622	832	2,040	8,032	----------
1904	5,414	236	2,437	853	2,182	5,184	----------
1905	8,797	231	2,952	515	3,499	5,645	----------
1906	5,101	230	4,019	636	1,740	2,100	----------
1907	7,027	72	3,293	904	4,091	6,386	----------
1908	5,067	141	3,179	947	5,508	3,467	----------
1909	3,148	185	3,589	860	4,121	3,458	----------
1910	4,504	191	2,988	1,036	583	610	----------
1911	6,433	248	3,091	411	3,099	1,439	----------
1912	6,317	163	3,060	481	2,660	1,548	----------
1913	5,816	144	4,756	532	4,293	1,383	400
1914	5,747	112	3,063	317	3,980	2,708	863
1915	6,236	95	3,584	286	7,345	3,574	652
1916	6,017	52	3,364	95	10,832	5,075	1,298
1917	3,525	24	1,724	42	12,032	5,410	1,280
1918	2,644	14	1,770	11	7,583	2,576	2,270
1919	2,025	38	2,100	15	4,315	1,398	2,452
1920	1,849	6	3,768	22	6,284	1,008	3,638
1921	2,060	38	5,618	48	2,735	650	2,605
1922	2,194	54	5,608	16	4,266	460	3,281
1923	2,911	87	4,873	2	10,684	881	3,437
1924	3,344	62	4,422	1	8,474	1,283	4,335
1925	3,606	107	3,553	8	24,115	2,095	6,638
1926	2,694	34	3,426	5	35,123	1,109	6,779
1927	2,693	34	4,773	6	31,354	176	8,359
1928	2,350	7	3,382	4	24,165	88	10,414
1929	3,471	12	2,695	(1)	37,521	222	10,788

Landings by fishing vessels at Boston, Gloucester, and Portland, 1893 to 1929—Continued

[Expressed in thousands of pounds, that is, 000 omitted]

BY SPECIES—Continued

Year	Herring		Swordfish		Other		Total	
	Fresh	Salted	Fresh	Salted	Fresh	Salted	Fresh	Salted
1893					1,045	837	95,996	46,400
1894	799	1,224	417		285	99	121,119	45,996
1895					1,717	1,869	99,677	50,762
1896					1,549	620	83,745	46,929
1897					8,354	2,926	95,664	31,201
1898	6,138	4,244			1,448	392	107,881	35,523
1899	6,082	7,412			2,730	91	127,274	49,500
1900					5,184	7,276	107,183	55,036
1901	1,719	10,030			1,475	2,157	96,439	54,726
1902	2,637	10,023			2,091	1,395	117,223	50,731
1903	3,097	7,887			2,847	1,790	111,442	46,050
1904	2,917	16,270	2,151	3	117		125,771	45,395
1905	6,882	8,569	2,009		172	14	169,535	35,352
1906	5,273	10,935	928		517	12	136,518	33,884
1907	5,402	15,614	2,044		2,142		151,775	39,797
1908	6,708	8,629	1,358		880		144,596	36,869
1909	4,421	9,278	1,637		1,059	27	124,631	48,471
1910	4,994	14,720	1,039		592		138,043	43,692
1911	6,399	16,752	1,503		1,807	11	144,864	40,288
1912	5,885	10,005	1,810		3,297		151,421	31,283
1913	2,070	9,677	2,376	5	2,875		133,970	28,247
1914	4,910	5,839	1,500		3,059		141,575	21,014
1915	4,346	8,931	2,239		3,222	(1)	147,075	24,521
1916	11,410	7,223	1,773		5,732	1	165,321	20,503
1917	6,817	6,322	1,973		3,858		156,783	18,647
1918	8,764	6,233	1,034		2,265		193,024	12,477
1919	6,858	3,502	883		1,702	11	186,543	9,938
1920	3,901	3,097	2,532		1,348		170,167	8,113
1921	2,262	351	1,598		491	1	144,259	6,606
1922	752	1,892	3,282		2,178	44	152,189	7,685
1923	264	1,219	2,455		561	9	168,216	6,746
1924	1,467	2,943	2,023		873		175,821	7,127
1925	1,542	2,400	1,527		1,046		209,017	7,852
1926	1,266	315	2,442		710		232,247	6,179
1927	2,735	4,410	2,246		1,591		257,158	6,691
1928	706	1,411	2,544		1,816		275,297	2,685
1929	1,038	3,518	4,593		2,771		322,203	4,893

BY PORTS

Year	Boston		Gloucester		Portland		Total	
	Fresh	Salted	Fresh	Salted	Fresh	Salted	Fresh	Salted
1893	66,518	1,077	29,478	45,323			95,996	46,400
1894	86,129	1,335	34,990	44,661			121,119	45,996
1895	73,612	195	26,065	50,567			99,677	50,762
1896	61,820	1,256	21,925	45,673			83,745	46,929
1897	62,704	199	32,960	31,002			95,664	31,201
1898	53,494	1,186	54,387	34,337			107,881	35,523
1899	63,450	1,274	63,824	48,226			127,274	49,500
1900	63,648	3,173	43,535	51,863			107,183	55,036
1901	56,855	2,137	39,584	52,589			96,439	54,726
1902	77,608	1,365	39,615	49,366			117,223	50,731
1903	78,383	1,883	33,059	44,167			111,442	46,050
1904	81,183	911	44,588	44,484			125,771	45,395
1905	101,085	222	68,450	35,130			169,535	35,352
1906	89,610	83	46,908	33,801			136,518	33,884
1907	87,717	394	64,058	39,403			151,775	39,797
1908	94,713	947	49,883	35,922			144,596	36,869
1909	92,085	491	32,546	47,980			124,631	48,471
1910	102,059	31	35,984	43,661			138,043	43,692
1911	93,629	131	51,235	40,157			144,864	40,288
1912	100,157	143	51,264	31,140			151,421	31,283
1913	92,202	149	41,768	28,098			133,970	28,247
1914	92,231	113	49,344	20,901			141,575	21,014
1915	97,397	502	49,678	24,019			147,075	24,521
1916	98,255	76	46,515	20,165	20,551	262	165,321	20,503

[1] Less than 500 pounds.

NOTE.—Prior to 1916, Portland landings are lacking.

Landings by fishing vessels at Boston, Gloucester, and Portland, 1893 to 1929—Continued

[Expressed in thousands of pounds, that is, 000 omitted]

BY PORTS—Continued

Year	Boston		Gloucester		Portland		Total	
	Fresh	Salted	Fresh	Salted	Fresh	Salted	Fresh	Salted
1917	98, 155	495	40, 062	18, 073	18, 566	79	156, 783	18, 647
1918	109, 227	249	62, 002	12, 173	21, 795	55	193, 024	12, 477
1919	103, 209	183	61, 621	9, 749	21, 713	6	186, 543	9, 938
1920	118, 302	257	39, 113	7, 627	12, 752	229	170, 167	8, 113
1921	104, 277	91	26, 747	6, 269	13, 235	246	144, 259	6, 606
1922	106, 032	158	30, 395	7, 355	15, 762	172	152, 189	7, 685
1923	123, 982	253	29, 012	6, 018	15, 222	475	168, 216	6, 746
1924	130, 631	335	29, 263	6, 583	15, 927	209	175, 821	7, 127
1925	148, 723	315	42, 161	7, 311	18, 133	226	209, 017	7, 852
1926	167, 061	257	49, 222	5, 679	15, 964	243	232, 247	6, 179
1927	194, 877	64	46, 056	6, 497	16, 225	130	257, 150	6, 691
1928	218, 353	34	39, 407	2, 497	17, 536	154	275, 297	2, 685
1929	255, 623	99	49, 135	4, 745	17, 415	50	322, 203	4, 893

NOTE.—Prior to 1916, Portland landings are lacking.

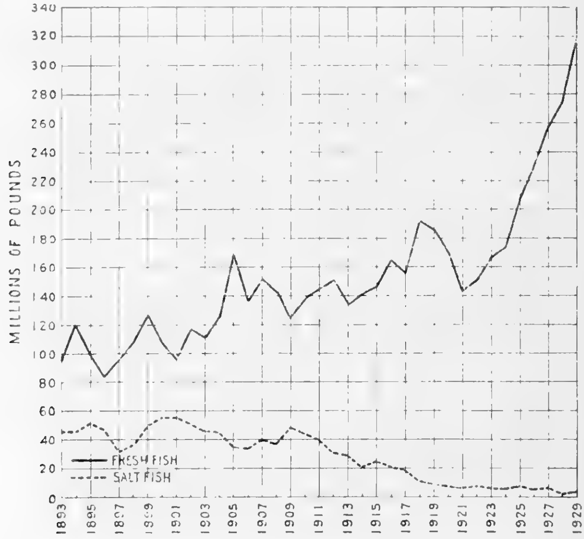

FIGURE 16.—Landings of fresh and salted fish by fishing vessels at the principal New England ports

BIOLOGICAL ASPECT

The fishing grounds of the North Atlantic, extending from Flemish Cap in 40° 06′ west longitude and 47° north latitude for a distance of about 2,000 miles to New York, provide an almost continuous extent of most productive fishing grounds. Fishing vessels landing fares at Boston and Gloucester, Mass., and Portland, Me., make their catches on certain of these grounds. A discussion of the activities of these vessels during 1929 is contained in this section.

In 1929 the fishing fleet landing fares at the three New England ports numbered 438 steam, motor, and sail vessels, of over 5 net tons, as measured by the United States Customs Service. These made 11,882 trips to the fishing grounds, and were absent from port 55,880 days, or, on the average, about 4.7 days per trip. Their catches of edible fish landed at the three ports amounted to 329,977,722 pounds when the salted fish had been converted to the basis of fresh gutted fish. This does not represent the entire catch of edible fish of these vessels, for small quantities, estimated at not more than 5 per cent of their total catch, were landed at ports in New England, other than these three, at New York City, and at ports in New Jersey.

The fishing vessels landing fares at these three ports did not always operate the same type of gear throughout the entire year. At one season a certain vessel may be outfitted as a line trawler; at another season as a purse seiner; and at still another season for swordfishing

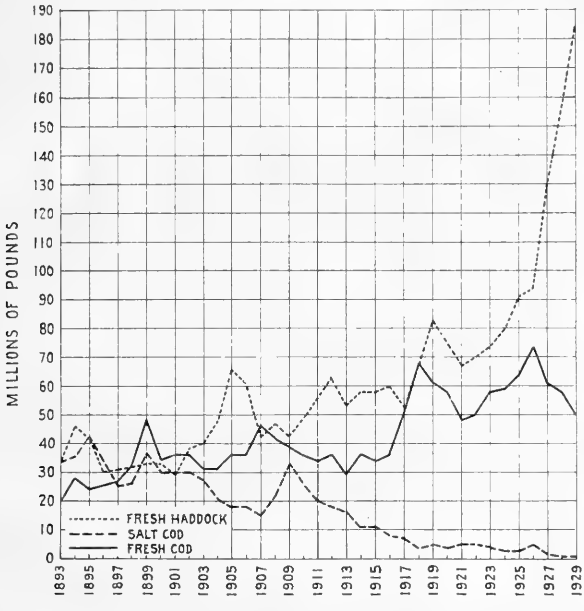

FIGURE 17.—Landings of cod and haddock by fishing vessels at the principal New England ports, 1893 to 1929. (Landings of salted haddock never reach over 650,000 pounds in any year and therefore have been omitted)

with harpoons. Thus, vessels may be fished with two or more types of gear during the course of a year. In such a case the vessel is classed with others operating similar gear, while it is fishing that type of gear.

From the tables it will be noted that the grand total of the number of vessels operated is exclusive of duplication, and that the total number of vessels operating each type of gear also is shown.

Line trawls.—A line-trawl fishery was prosecuted by 106 vessels in 1929. These vessels made 1,824 trips to 23 main fishing grounds, and were absent from port 11,518 days, or an average of about 6.3 days per trip. Their catches aggregated 69,935,942 pounds, or 21 per cent of the total landings by vessels at the three ports. Of this amount, haddock constituted 44 per cent, cod 34 per cent, and hake 11 per cent. Other species of importance in the catch by line trawls were cusk, halibut, and pollock. Of the total catch, 43 per cent were taken in South Channel, 21 per cent on Browns Bank, and 13 per cent on Georges Bank. Other banks on which considerable quantities of fish were taken by line trawls were Jeffreys Ledge and Sable Island Bank.

Hand lines.—A hand-line fishery was prosecuted by 31 vessels in 1929. These vessels made 274 trips to nine main fishing grounds, and were absent from port, 2,221 days, or an average of about 8.1 days per trip. Their catches aggregated 9,036,327 pounds, or 3 per cent of the total landings at the three ports. Of this amount, cod constituted 82 per cent, haddock 9 per cent, and pollock 5 per cent. Only minor amounts of other species were taken by hand lines. Of the total catch, 70 per cent were taken on Georges Bank and 13 per cent on Nantucket Shoals. Other grounds on which considerable quantities of fish were taken by hand lines are Cape Shore and Browns Bank.

Harpoons.—A fishery with harpoons was prosecuted by 81 vessels in 1929. These vessels made 296 trips to 5 main fishing grounds, and were absent from port 4,557 days, or an average of about 15.3 days per trip. Their catch amounted to 4,464,613 pounds of swordfish and 7,258 pounds of other fish, or a total a little over 1 per cent of the total landings by vessels at the three ports. Of the total catch, 91 per cent were taken on Georges Bank.

Otter trawls, large vessels.—A fishery with otter trawls was prosecuted by 64 vessels of 91 net tons and over in 1929. These vessels made 1,240 trips to eight main fishing grounds, and were absent from port 10,839 days, or an average of 8.7 days per trip (7.7 days in 1928). This is an increase of 21 vessels over the number operated in 1928, an increase of 24 per cent in the number of trips, and an increase of 39 per cent in the number of days absent. The catch amounted to 92,674,689 pounds, or 28 per cent of the total landings by vessels at the three ports. Of the total 81 per cent consisted of haddock, 10 per cent of cod, 3 per cent each of flounders, hake, and pollock. Only minor quantities of other species were taken by large otter trawls. Of the total catch, 66 per cent were taken on Georges Bank and 30 per cent on South Channel. Only minor catches were made on the other grounds where large otter trawlers fished.

Cod, haddock, and hake landed at Boston and Gloucester, Mass., and Portland, Me., by large otter trawlers and large V–D otter trawlers in various years, 1908 to 1929

Year	Trips	Cod	Haddock	Hake	Year	Trips	Cod	Haddock	Hake
		Pounds	*Pounds*	*Pounds*			*Pounds*	*Pounds*	*Pounds*
1908	44	209, 800	1, 542, 000	46, 600	1922	578	11, 161, 947	35, 878, 524	576, 370
1909	47	159, 800	1, 719, 000	74, 400	1923	665	14, 961, 590	35, 527, 297	471, 600
1910	59	125, 850	2, 775, 000	46, 600	1924	543	8, 231, 430	35, 197, 940	616, 853
1911	178	564, 500	7, 367, 100	151, 700	1925	607	7, 309, 930	44, 034, 281	711, 212
1912	295	1, 952, 950	12, 966, 700	105, 500	1926	667	5, 203, 911	52, 405, 653	894, 885
1913	326	1, 667, 806	12, 488, 992	209, 485	1927	794	3, 982, 905	69, 237, 652	994, 730
1914	387	1, 149, 595	15, 383, 550	259, 913	1928	1, 010	6, 295, 138	75, 876, 486	1, 455, 675
1920	646	6, 311, 389	51, 962, 457	----------	1929	1, 240	8, 884, 698	74, 776, 042	2, 569, 051
1921	346	2, 482, 833	26, 734, 893	241, 650					

Otter trawls, medium vessels.—A fishery with otter trawls was also prosecuted by 96 vessels of 21 to 90 net tons, inclusive, in 1929.

Medium large trawlers are referred to by some in the fisheries as "draggers." These vessels made 1,064 trips to 12 main fishing grounds and were absent from port 6,673 days, or an average of 6.3 days per trip. Their catches aggregated 32,423,005 pounds, or about 10 per cent of the total landings by vessels at the three ports. Of this, haddock constituted 82 per cent, flounders 9 per cent, and cod 6 per cent. Only minor quantities of other species were taken by medium otter trawlers. Of the total catch, 63 per cent were taken on Georges Bank, and 28 per cent on South Channel. Only minor quantities were taken on the other grounds where this type of vessel fished.

Otter trawls, small vessels.—A fishery with otter trawls was also prosecuted by 96 vessels of 5 to 20 net tons, inclusive, in 1929. Small otter trawlers are referred to by some in the fisheries as "flounder draggers." These vessels made 850 trips to nine main fishing grounds, and were absent from port 3,040 days, or an average of 3.6 days per trip. Their catches aggregated 8,212,090 pounds, or about 3 per cent of the total landings by vessels at the three ports. Of this amount, 52 per cent consisted of haddock, and 38 per cent of flounders. Of the total catch, 43 per cent were taken on banks along the shore, 31 per cent on Georges Bank, and 15 per cent on South Channel.

V–D trawls (otter trawls), large vessels.—A fishery with V–D otter trawls was prosecuted by 26 vessels of 91 net tons and over in 1929. These vessels made 305 trips to four main fishing grounds, and were absent from port 2,362 days, or an average of 7.7 days per trip. Their catches aggregated 26,847,877 pounds, or 8 per cent of the total landings by vessels at the three ports. Of this amount, 86 per cent consisted of haddock, and 8 per cent of cod. Of the total catch, 61 per cent were taken on Georges Bank and 32 per cent on South Channel.

V–D trawls (otter trawls), medium vessels.—A fishery with V–D otter trawls was prosecuted by 41 vessels of 21 to 90 net tons, inclusive, in 1929. These vessels made 695 trips to eight main fishing grounds, and were absent from port 4,991 days, or an average of 7.2 days per trip. Their catches amounted to 28,253,826 pounds, or, about 9 per cent of the total landings by vessels at the three ports. Of this amount, 89 per cent consisted of haddock, and 5 per cent consisted of cod. The remainder was made up chiefly of flounders, hake, and pollock. Of the total catch, 60 per cent were made on Georges Bank, and 36 per cent on South Channel. Only very minor quantities were taken on the other banks where these vessels fished.

V–D trawls (otter trawls), small vessels.—A fishery with V–D otter trawls was prosecuted by 3 vessels of 5 to 20 net tons, inclusive, in 1929. These vessels made nine trips to four main fishing grounds, and were absent from port 60 days, or an average of 6.7 days per trip. Their catch aggregated 220,758 pounds, and consisted almost entirely of haddock, and were taken mainly on Georges Bank.

Sink gill nets.—A fishery with sink gill nets was prosecuted by 49 vessels in 1929. These made 3,318 trips to four main fishing grounds, and were absent from port 3,487 days, or an average of about 1 day per trip. The catch amounted to 13,073,990 pounds, or 4 per cent of the total landings by vessels at the three ports. Of this amount 45 per cent consisted of pollock, 38 per cent of cod, and 9 per cent of haddock. Only minor quantities of other species were taken with this type of gear. Of the total catch, 92 per cent were made on those grounds near the shore.

Drift gill nets.—A fishery with drift gill nets was prosecuted by 97 vessels in 1929. They made 501 trips to three main fishing grounds, and were absent from port 1,411 days, or an average of 2.8 days per trip. Their catch amounted to 6,117,493 pounds, or about 2 per cent of the total landings by vessels at the three ports. Of this amount, 86 per cent consisted of herring, which were taken on Bay of Islands fishing grounds. The remainder consisted mostly of mackerel, which were taken on grounds near the shore.

Purse seines.—A fishery with purse seines (mackerel fishery) was prosecuted by 113 vessels in 1929. They made 1,504 trips to 14 main fishing grounds, and were absent from port 4,712 days, or an average of about 3.1 days per trip. Their landings at the three New England ports amounted to 38,704,258 pounds, or 12 per cent of the total landings by vessels at these ports. Of this amount, 95 per cent consisted of mackerel, and the remainder mostly of herring. Of the total, 51 per cent were taken on shore grounds and 26 per cent on South Channel. Only minor quantities were taken on other banks where these vessels fished.

Scallop drags or trawls.—A fishery with scallop drags or trawls was prosecuted by two vessels in 1929. These made two trips to Boston and were absent from port nine days. The catch consisted of 5,596 pounds of scallop meats, and was taken on Georges Bank and banks along the shore.

Summary.—In general, regular otter trawls were the most important gear used by the vessels landing fish at the three New England ports, catching 40 per cent of the total landings. Line trawls were next in importance, catching 21 per cent of the total. The various sizes of V–D otter trawl vessels caught 17 per cent; purse seines, 12 per cent; sink gill nets, 4 per cent; hand lines, 3 per cent; and harpoons, drift gill nets, and scallop drags the remaining 3 per cent.

Among the fishing grounds Georges Bank was the most important, furnishing 42 per cent of the fish caught by the vessels. South Channel, which is near Georges Bank, was second, and furnished 29 per cent. In 1928 the best fishing was on South Channel. Shore grounds furnished 12 per cent, and Browns Bank 5 per cent. All of these grounds are off the United States. The catch on any one of the other banks or grounds where fishing was prosecuted by the vessels furnished less than 7,500,000 pounds each.

The fishery products landed at the three ports by vessels are taken chiefly on fishing grounds off the United States west of 66° west longitude. In 1929 these grounds furnished 95 per cent of the total landings by vessels at the three ports.

Those fishing grounds off Canadian Provinces east of 66° west longitude furnished 3 per cent, while those off Newfoundland, also east of 66° west longitude, furnished 2 per cent. The large catch on grounds off the United States is due chiefly to the large catches by otter trawlers on Georges Bank, South Channel, and Nantucket Shoals, which fishing grounds are suited to this type of gear, and which are comparatively near packing centers. Compared with 1928, there was an increase of 21 per cent in the landings of fish taken on grounds off the United States, a decrease of 43 per cent in the landings of fish taken off Canadian Provinces, and an increase of 54 per cent in the landings of fish taken off Newfoundland, the latter being due principally to the large amount of herring taken on these grounds.

Landings by fishing vessels at the three principal New England ports, 1929

BY GEAR AND FISHING GROUNDS

Gear and fishing grounds	Vessels fishing	Trips	Days absent	Cod			Haddock		Hake	
				Large	Market	Scrod	Large	Scrod	Large	Small
	Number	*Number*	*Number*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Line trawls:										
Grand Bank	11	24	637	486,115	44,484				3,550	
Green Bank	2	3	74	6,945	537				6,660	1,089
St. Peters Bank	3	7	174	160					1,425	
Off Newfoundland	1	1	45							
Labrador coast	2	2	84	10,450	3,783					
Gulf of St. Lawrence	3	4	156	173,892	23,232				75	
Scatari Bank	1	1	33	7,410	825					
Quereau Bank	2	3	51	55,246	6,537				2,390	733
The Gully	2	3	46	5,320						
Sable Island Bank (Western Bank)	8	18	354	1,169,237	840,720		178,285		18,267	
Cape Shore	7	12	124	111,780	102,400	180	357,260		33,820	
La Have Bank	15	27	345	511,521	328,601		781,825	4,400	84,563	
Browns Bank	38	209	2,096	3,068,704	1,674,513	18,750	7,871,150	8,900	342,365	170
Georges Bank	49	161	1,681	4,879,104	624,856	375	2,516,685	19,880	86,019	
South Channel	48	538	3,314	4,744,215	3,428,498	12,390	14,550,602	47,705	4,921,710	
Off Chatham	10	20	120	46,845	30,595	300	529,225	3,600	33,490	
Nantucket Shoals	6	9	72	107,215	171,780	2,850	39,400	1,500		
Cashes Bank	31	89	360	314,100	88,680	5,825	480,033	14,299	407,072	201,572
Fippenies Bank	8	14	48	46,400	15,935	120	81,530	1,780	51,600	34,060
Platts Bank	10	51	117	86,070	25,445	2,679	164,529	9,618	4,300	254,320
Jeffreys Ledge	30	315	702	232,910	92,508	13,260	1,608,038	50,380	86,370	446,683
Middle Bank (Stellwagen Bank)	14	88	328	101,470	48,572	1,425	714,175	16,300	467,950	
Shore, general	37	225	557	169,844	68,423	16,876	748,150	35,580	26,320	165,784
Total	[1] 106	1,824	11,518	16,334,953	7,620,924	75,030	30,620,887	213,942	6,577,856	1,104,411
Hand lines:										
Grand Bank	1	1	29	22,914	252				970	
Cape Shore	11	16	146	175,060	252,475	200	35,190	2,350	19,550	
La Have Bank	1	1	8	8,500	10,500		38,900			
Browns Bank	10	14	105	186,675	246,750		21,095		175	
Georges Bank	19	181	1,496	3,164,960	2,098,568	5,600	531,790	9,125	5,080	
South Channel	5	6	45	70,050	70,550		97,650		8,900	
Nantucket Shoals	10	53	388	505,012	602,290	11,355	35,720	3,750	15,775	
Middle Bank (Stellwagen Bank)	1	1	3	740	1,500		9,750		6,900	
Shore, general	1	1	1	315	195	5	9			8
Total	[1] 31	274	2,221	4,134,226	3,283,080	17,160	770,104	15,225	57,350	8

[1] Exclusive of duplication.

Landings by fishing vessels at the three principal New England ports, 1929—Continued

BY GEAR AND FISHING GROUNDS—Continued

Gear and fishing grounds	Vessels fishing	Trips	Days absent	Cod			Haddock		Hake	
				Large	Market	Scrod	Large	Scrod	Large	Small
	Number	*Number*	*Number*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Harpoons:										
Cape Shore	7	7	145							
Browns Bank	13	13	202							
Georges Bank	79	270	4,127							
Nantucket Shoals	1	1	9							
Shore, general	5	5	74							
Total	[1] 81	296	4,557							
Otter trawls, large:										
Sable Island Bank (Western Bank)	1	1	10	1,400	2,850	1,100	42,300	8,100	375	
La Have Bank	18	25	273	60,765	97,535	2,230	1,108,630	132,640	43,285	
Browns Bank	1	1	11	1,940	1,690		35,450	550	270	
Georges Bank	59	762	6,625	3,515,153	2,532,970	49,335	47,222,528	3,314,132	1,151,959	6,335
Clark Bank	1	1	5	1,470	430	100	27,895	2,950	145	
South Channel	49	423	3,667	1,380,515	1,145,790	24,005	20,166,344	1,465,245	1,314,345	3,222
Nantucket Shoals	16	26	242	18,915	33,005	7,975	1,164,763	48,815	42,615	
Middle Bank (Stellwagen Bank)	1	1	6	4,025	1,500		34,500	1,200	6,500	
Total	[1] 64	1,240	10,839	4,984,183	3,815,770	84,745	69,802,410	4,973,632	2,559,494	9,557
Otter trawls, medium:										
Cape Shore	1	1	17	31,800	27,600		5,000		1,000	
La Have Bank	2	2	18	3,080	5,600		108,310	5,240	175	
Browns Bank	2	2	15	13,150	10,720		96,630	7,000	400	
Georges Bank	66	526	3,785	566,934	464,844	12,210	16,323,727	1,094,220	111,000	5,250
Clark Bank	1	1	6	4,500	800		41,000			
South Channel	52	269	1,838	237,933	396,278	14,690	6,876,034	364,815	204,845	
Off Chatham	11	21	125	16,580	8,150		197,400	19,705	14,800	
Nantucket Shoals	23	55	376	24,645	199,285	18,135	922,882	45,775	12,550	
Platts Bank	1	1	3	870	1,250		17,085	1,350		1,970
Jeffreys Ledge	2	3	9	1,175	625		16,550	960	3,090	
Middle Bank (Stellwagen Bank)	1	1	3	250	100		5,500	55	3,600	
Shore, general	30	182	478	47,386	41,614	570	432,005	34,345	21,065	404
Total	[1] 96	1,064	6,673	948,303	1,156,866	45,605	25,042,123	1,573,465	372,525	7,624

Otter trawls, small:											
Seal Island Grounds	1	1	2	20			650	45		35
Browns Bank	1	1	5		200		35,000	5,500		
Georges Bank	16	97	664	45,825	54,190	3,430	1,884,125	120,455	13,920	
South Channel	16	57	343	39,253	78,380	4,775	859,636	31,810	17,445	
Off Chatham	6	10	51	3,191	3,345		78,120	2,850	2,025	
Nantucket Shoals	21	49	293	10,372	50,180	7,895	161,745	12,680	3,030	
Jeffreys Ledge	3	3	12	285	250		13,080	430	250	
Middle Bank (Stellwagen Bank)	6	8	24	4,325	2,140	70	7,745	610	1,700	
Shore, general	82	624	1,646	100,413	100,075	11,356	1,029,662	31,440	88,703	23,939
Total	[1] 96	850	3,040	203,684	288,760	27,526	4,069,763	205,820	127,073	23,974
V-D trawls, large:										
La Have Bank	4	5	50	12,900	20,345	850	231,700	34,300	4,165	
Georges Bank	17	173	1,322	856,820	579,740	950	13,184,629	1,047,115	152,021	
South Channel	15	105	795	303,012	271,090	1,500	6,714,900	595,930	161,365	
Nantucket Shoals	10	22	195	23,450	26,040	2,050	1,337,970	52,910	20,075	
Total	[1] 26	305	2,362	1,196,182	897,215	5,350	21,469,199	1,730,255	337,626	
V-D trawls, medium:										
La Have Bank	5	6	53	7,945	12,200		219,900	11,100	5,300	
Browns Bank	2	2	16	1,900	3,950		108,100	5,700		
Georges Bank	36	389	2,781	444,683	360,760	7,845	14,271,591	1,016,400	179,880	
Clark Bank	4	5	32	1,235	2,150	200	103,350	4,325	6,225	
South Channel	36	272	1,960	358,332	316,545	4,985	8,353,475	633,965	231,727	
Off Chatham	9	11	72	7,925	4,425		194,328	18,340	12,375	
Nantucket Shoals	7	8	63	3,825	4,155		236,895	9,670	5,200	
Shore, general	2	2	14	80	200		94,950	3,825		
Total	[1] 41	695	4,991	825,925	704,385	13,030	25,582,589	1,703,325	440,707	
V-D trawls, small:										
Georges Bank	2	5	37	4,390	8,300	600	106,650	10,450	2,850	
South Channel	1	2	12		330		32,000	4,500	200	
Nantucket Shoals	1	1	6	400	1,000	3,000	8,500	400	75	
Shore, general	1	1	5		225		11,200	1,000	900	
Total	[1] 3	9	60	4,790	9,855	3,600	158,350	16,350	4,025	
Sink gill nets:										
Platts Bank	1	1	1	890						310
Jeffreys Ledge	10	186	206	320,460	11,371	35	15,150	250	2,107	76,924
Middle Bank (Stellwagen Bank)	16	63	66	198,235						
Shore, general	48	3,068	3,214	4,326,488	72,864	530	1,230,839	835	276,290	80,660
Total	[1] 49	3,318	3,487	4,846,073	84,235	565	1,245,989	1,085	278,397	157,894

[1] Exclusive of duplication.

Landings by fishing vessels at the three principal New England ports, 1929—Continued

BY GEAR AND FISHING GROUNDS—Continued

Gear and fishing grounds	Vessels fishing	Trips	Days absent	Cod			Haddock		Hake	
				Large	Market	Scrod	Large	Scrod	Large	Small
	Number	*Number*	*Number*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Drift gill nets:										
Bay of Islands	10	11	380							
South	13	13	55							
Shore, general	86	477	976	17,290					5,680	
Total	[1] 97	501	1,411	17,290					5,680	
Purse seines:										
Sable Island Bank (Western Bank)	1	1	1	8,550	21,100		9,220		100	
Cape Shore	11	15	118							
Georges Bank	33	44	230							
South Channel	72	320	1,209							
Off Highland Light	1	1	4							
Off Chatham	67	181	748							
Nantucket Shoals	9	9	46							
Cashes Bank	6	18	36		100					
Platts Bank	1	3	6							
Jeffreys Ledge	42	55	136	1,365						200
Ipswitch Bay	6	7	13							
Middle Bank (Stellwagen Bank)	1	1	3							
South	30	39	162							
Shore, general	109	810	2,000	2,599	1,395					
Total	[1] 113	1,504	4,712	12,514	22,595		9,220		100	200
Scallop drags:										
Georges Bank	1	1	5							
Shore, general	1	1	4							
Total	[1] 2	2	9							
Grand total	[1] 438	11,882	55,880	33,508,123	17,883,685	272,611	176,770,634	10,433,099	10,760,833	1,303,668

[1] Exclusive of duplication.

NOTE.—The three principal New England ports are Boston and Gloucester, Mass., and Portland, Me. Otter trawls and V-D trawls are classified according to the size of the vessel. The weight of salted fish landed has been converted to the equivalent of fresh fish as landed. Only landings by vessels having a capacity of 5 net tons or greater are used in this tabulation.

Gear and fishing grounds	Pollock	Cusk	Halibut	Flounders	Swordfish	Mackerel	Herring	Other	Total
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Line trawls:									
Grand Bank	532	882	814, 930		14, 813			1, 945	1, 367, 251
Green Bank		1, 200	65, 520		679				82, 630
St. Peters Bank		380	227, 725						229, 690
Off Newfoundland			4, 383						4, 383
Labrador coast			49, 595						63, 828
Gulf of St. Lawrence	142	10, 932	21, 108						229, 381
Scatari Bank		2, 470	8, 791						19, 496
Quereau Bank	570	1, 058	37, 797		157				104, 398
The Gully			74, 166						79, 486
Sable Island Bank (Western Bank)	4, 055	12, 580	51, 862		258				2, 275, 264
Cape Shore	34, 720	20, 400	2, 845					2, 150	665, 555
La Have Bank	10, 006	125, 685	124, 322		2, 053			11, 420	1, 984, 396
Browns Bank	230, 216	758, 885	254, 181	929	31, 665			100, 340	14, 360, 768
Georges Bank	93, 335	107, 731	425, 792	14, 460	25, 782			8, 677	8, 802, 696
South Channel	746, 405	1, 110, 095	79, 674	28, 375				62, 946	29, 732, 615
Off Chatham	5, 640	4, 385	4, 731					3, 645	662, 456
Nantucket Shoals	1, 450		19, 789						343, 984
Cashes Bank	24, 995	394, 648	17, 798	255				45, 130	1, 994, 407
Fippenies Bank	2, 235	50, 465	501					4, 645	289, 271
Platts Bank	16, 357	59, 613	876					34, 457	658, 264
Jeffreys Ledge	84, 658	234, 647	2, 001	4, 330				141, 804	2, 997, 589
Middle Bank (Stellwagen Bank)	39, 485	125, 645	1, 383					5, 040	1, 521, 445
Shore, general	19, 630	127, 644	2, 142	19, 886				66, 410	1, 466, 689
Total	1, 314, 431	3, 149, 345	2, 291, 912	68, 235	75, 407			488, 609	69, 935, 942
Hand lines:									
Grand Bank			33, 426						57, 562
Cape Shore	59, 420	55, 395	1, 695		774			15, 440	617, 549
La Have Bank		1, 500	688						60, 088
Browns Bank	22, 045	19, 930	11, 206		2, 396			8, 315	518, 587
Georges Bank	287, 269	44, 955	91, 509	1, 325	21, 136			33, 400	6, 294, 717
South Channel	19, 875	1, 450	1, 481					620	270, 576
Nantucket Shoals	18, 435	600	1, 859		377			1, 800	1, 196, 973
Middle Bank (Stellwagen Bank)	550	140	63					100	19, 743
Shore, general									532
Total	407, 594	123, 970	141, 927	1, 325	24, 683			59, 675	9, 036, 327

Landings by fishing vessels at the three principal New England ports, 1929—Continued

BY GEAR AND FISHING GROUNDS—Continued

Gear and fishing grounds	Pollock	Cusk	Halibut	Flounders	Swordfish	Mackerel	Herring	Other	Total
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Harpoons:									
Cape Shore					57, 091				57, 091
Browns Bank					282, 486				282, 486
Georges Bank					4, 071, 201			7, 258	4, 078, 459
Nantucket Shoals					3, 742				3, 742
Shore, general					50, 093				50, 093
Total					4, 464, 613			7, 258	4, 471, 871
Otter trawls, large:									
Sable Island Bank (Western Bank)	1, 250	45	130	90				1, 000	58, 640
La Have Bank	20, 125	2, 402	4, 118	40, 525				29, 380	1, 541, 635
Browns Bank	160			800					40, 860
Georges Bank	1, 318, 824	112, 975	107, 065	1, 900, 207	149	3, 130		314, 405	61, 549, 167
Clark Bank	200		119	200				160	33, 669
South Channel	1, 059, 945	46, 903	60, 909	1, 082, 060		7, 850		185, 480	27, 942, 613
Nantucket Shoals	20, 925	65	1, 001	103, 735		525		11, 175	1, 453, 514
Middle Bank (Stellwagen Bank)	850	350	206	5, 100				360	54, 591
Total	2, 422, 279	162, 740	173, 548	3, 132, 717	149	11, 505		541, 960	92, 674, 689
Otter trawls, medium:									
Cape Shore	500								65, 900
La Have Bank	400		223	1, 130				1, 850	126, 008
Browns Bank	800	3, 600		180					132, 480
Georges Bank	25, 870	1, 470	17, 497	1, 615, 299	13, 032	457		52, 693	20, 304, 503
Clark Bank				150					46, 450
South Channel	35, 715	1, 480	6, 687	752, 518	3, 884	878		41, 464	8, 937, 221
Off Chatham	975		162	45, 175				11, 235	314, 182
Nantucket Shoals	5, 750		146	342, 410				1, 035	1, 572, 613
Platts Bank	120			1, 315				1, 555	25, 515
Jeffreys Ledge	170	580		1, 680				200	25, 030
Middle Bank (Stellwagen Bank)	150	500						30	10, 185
Shore, general	29, 190	790	465	244, 874		5, 900		4, 310	862, 918
Total	99, 640	8, 420	25, 180	3, 004, 731	16, 916	7, 235		114, 372	32, 423, 005

Otter trawls, small:									
Seal Island Grounds				900					1,650
Browns Bank			21	6,000					46,721
Georges Bank	4,595	200	3,720	383,925	121			8,767	2,523,273
South Channel	865		2,712	170,605				13,589	1,219,070
Off Chatham	125		105	20,165				8,785	118,711
Nantucket Shoals	185		291	468,565				1,415	716,358
Jeffreys Ledge	50	500		1,900				1,706	18,451
Middle Bank (Stellwagen Bank)	50			14,175					30,815
Shore, general	5,560	423	8,095	2,091,540		35		45,800	3,537,041
Total	11,430	1,123	14,944	3,157,775	121	35		80,062	8,212,090
V-D trawls, large:									
La Have Bank	4,110	300	1,136	1,665				3,045	314,516
Georges Bank	193,030	18,025	18,606	359,345		68		70,596	16,480,945
South Channel	110,310	14,820	13,156	237,330		1,270		73,363	8,498,046
Nantucket Shoals	18,860	100	710	58,830		5,560		7,815	1,554,370
Total	326,310	33,245	33,608	657,170		6,898		154,819	26,847,877
V-D trawls, medium:									
La Have Bank	620	250	102	5,505				950	263,872
Browns Bank	200		116	1,050				430	121,446
Georges Bank	61,370	5,740	7,669	432,900	6,526	2,108		37,589	16,835,061
Clark Bank	3,470	175	175	4,025				160	125,490
South Channel	51,745	4,100	6,430	235,780	4,047	3,673		48,624	10,253,428
Off Chatham	4,710			17,850				3,845	263,798
Nantucket Shoals	1,050		115	24,085		220		335	285,550
Shore, general			101	6,025					105,181
Total	123,165	10,265	14,708	727,220	10,573	6,001		91,933	28,253,826
V-D trawls, small:									
Georges Bank			23	19,025				120	152,408
South Channel				1,370				300	38,700
Nantucket Shoals				2,100					15,475
Shore, general				75				775	14,175
Total			23	22,570				1,195	220,758
Sink gill nets:									
Platts Bank	1,625							200	3,025
Jeffreys Ledge	305,525	1,875	207	2,372				57,837	794,113
Middle Bank (Stellwagen Bank)									198,235
Shore, general	5,548,191	2,540	251	5,330		211,929	54,800	267,070	12,078,617
Total	5,855,341	4,415	458	7,702		211,029	54,800	325,107	13,073,990

Landings by fishing vessels at the three principal New England ports, 1929—Continued

BY GEAR AND FISHING GROUNDS—Continued

Gear and fishing grounds	Pollock	Cusk	Halibut	Flounders	Swordfish	Mackerel	Herring	Other	Total
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Drift gill nets:									
Bay of Islands							5, 277, 240		5, 277, 240
South						74, 810		4, 000	78, 810
Shore, general	6, 130					729, 958		2, 385	761, 443
Total	6, 130					804, 768	5, 277, 240	6, 385	6, 117, 493
Purse seines:									
Sable Island Bank (Western Bank)	645								39, 615
Cape Shore						881, 300			881, 300
Georges Bank						979, 873	6, 000		985, 873
South Channel				8, 320		10, 085, 980	35, 750	340	10, 130, 390
Off Highland Light						49, 000			49, 000
Off Chatham					500	3, 733, 353	13, 000	93, 489	3, 840, 342
Nantucket Shoals						214, 730			214, 730
Cashes Bank						37, 401	219, 500	45, 400	302, 401
Platts Bank							23, 700		23, 700
Jeffreys Ledge	75					1, 372, 105	21, 000	44, 578	1, 439, 323
Ipswitch Bay						53, 110			53, 110
Middle Bank (Stellwagen Bank)						7, 310			7, 310
South						896, 365			896, 365
Shore, general	450					18, 462, 292	664, 100	709, 963	19, 840, 799
Total	1, 170			8, 320	500	36, 772, 819	983, 050	893, 770	38, 704, 258
Scallop drags:									
Georges Bank								3, 600	3, 600
Shore, general								1, 996	1, 996
Total								5, 596	5, 596
Grand total	10, 567, 490	3, 493, 523	2, 696, 308	10, 787, 765	4, 592, 962	37, 821, 190	6, 315, 090	2, 770, 741	329, 977, 722

SUMMARY: By fishing grounds

Fishing grounds	Vessels fishing	Trips	Days absent	Cod			Haddock		Hake	
				Large	Market	Scrod	Large	Scrod	Large	Small
East of 66° W. longitude										
Off Newfoundland:	*Number*	*Number*	*Number*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Grand Bank	11	25	666	509, 029	44, 736				4, 520	
Green Bank	2	3	74	6, 945	537				6, 660	1, 089
St. Peters Bank	3	7	174	160					1, 425	
Bay of Islands	10	11	380							
Off Newfoundland	1	1	45							
Total	[1] 22	47	1, 339	516, 134	45, 273				12, 605	1, 089
Off Canada:										
Seal Island Grounds	1	1	2	20			650	45		35
Labrador Coast	2	2	84	10, 450	3, 783					
Gulf of St. Lawrence	3	4	156	173, 892	23, 232				75	
Scatari Bank	1	1	33	7, 410	825					
Quereau Bank	2	3	51	55, 246	6, 537				2, 300	733
The Gully	2	3	46	5, 320						
Sable Island Bank (Western Bank)	10	20	365	1, 179, 187	864, 670	1, 100	229, 805	8, 100	18, 742	
Cape Shore	35	51	550	318, 640	382, 475	380	397, 450	2, 350	54, 370	
La Have Bank	43	66	747	604, 711	474, 781	3, 080	2, 489, 265	187, 680	137, 488	
Total	[1] 80	151	2, 034	2, 354, 876	1, 756, 303	4, 560	3, 117, 170	198, 175	212, 975	768
West of 66° W. longitude										
Off United States:										
Browns Bank	61	242	2, 450	3, 272, 369	1, 937, 823	18, 750	8, 167, 425	27, 650	343, 210	170
Georges Bank	277	2, 609	22, 753	13, 477, 869	6, 724, 228	80, 345	96, 041, 725	6, 631, 777	1, 702, 729	11, 585
Clark Bank	6	7	43	7, 205	3, 380	300	172, 245	7, 275	6, 370	
South Channel	239	1, 992	13, 183	7, 133, 310	5, 707, 461	62, 345	57, 650, 641	3, 143, 970	6, 860, 537	3, 222
Off Highland Light	1	1	4							
Off Chatham	100	243	1, 116	74, 541	46, 515	300	999, 073	44, 495	62, 690	
Nantucket Shoals	98	233	1, 690	693, 834	1, 087, 735	53, 260	3, 907, 875	175, 500	99, 320	
Cashes Bank	37	107	396	314, 100	88, 780	5, 825	480, 033	14, 299	407, 072	201, 572
Fippenies Bank	8	14	48	46, 400	15, 935	120	81, 530	1, 780	51, 600	34, 060
Platts Bank	13	56	127	87, 830	26, 695	2, 679	181, 614	10, 968	4, 300	256, 600
Jeffreys Ledge	82	562	1, 065	556, 195	104, 754	13, 295	1, 652, 818	52, 020	91, 817	523, 807
Ipswitch Bay	6	7	13							
Middle Bank (Stellwagen Bank)	37	163	433	309, 045	53, 812	1, 495	771, 670	18, 165	486, 650	
South	40	52	217							
Shore, general	241	5, 396	8, 969	4, 664, 415	284, 991	29, 337	3, 546, 815	107, 025	418, 958	270, 795
Total	[1] 430	11, 684	52, 507	30, 637, 113	16, 082, 109	268, 051	173, 653, 464	10, 234, 924	10, 535, 253	1, 301, 811
Grand total	[1] 438	11, 882	55, 880	33, 508, 123	17, 883, 685	272, 611	176, 770, 634	10, 433, 099	10, 760, 833	1, 303, 668

[1] Exclusive of duplication.

Landings by fishing vessels at the three principal New England ports, 1929—Continued

SUMMARY: BY FISHING GROUNDS—Continued

Fishing grounds	Pollock	Cusk	Halibut	Flounders	Swordfish	Mackerel	Herring	Other	Total
East of 66° W. longitude	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Off Newfoundland:									
Grand Bank	532	882	848,356		14,813			1,945	1,424,813
Green Bank		1,200	65,520		679				82,630
St. Peters Bank		380	227,725						229,690
Bay of Islands							5,277,240		5,277,240
Off Newfoundland			4,383						4,383
Total	532	2,462	1,145,984		15,492		5,277,240	1,945	7,018,756
Off Canada:									
Seal Island Grounds				900					1,650
Labrador Coast			49,595						63,828
Gulf of St. Lawrence	142	10,932	21,108						229,381
Scatari Bank		2,470	8,791						19,496
Quereau Bank	570	1,058	37,797		157				104,398
The Gully			74,166						79,486
Sable Island Bank (Western Bank)	5,950	12,625	51,992	90	258			1,000	2,373,519
Cape Shore	94,640	75,795	4,540		57,865	881,300		17,590	2,287,395
La Have Bank	35,261	130,137	130,589	48,825	2,053			46,645	4,290,515
Total	136,563	233,017	378,578	49,815	60,333	881,300		65,235	9,449,668
West of 66° W. longitude									
Off United States:									
Browns Bank	253,421	782,415	265,524	8,959	316,547			109,085	15,503,348
Georges Bank	1,984,293	291,096	671,881	4,726,486	4,137,947	985,636	6,000	537,105	138,010,702
Clark Bank	3,670	175	294	4,375				320	205,609
South Channel	2,024,860	1,178,848	171,049	2,516,358	7,931	10,099,651	35,750	426,726	97,022,659
Off Highland Light						49,000			49,000
Off Chatham	11,450	4,385	4,998	83,190	500	3,733,353	13,000	120,999	5,199,489
Nantucket Shoals	66,655	765	23,911	999,725	4,119	221,035		23,575	7,357,309
Cashes Bank	24,995	394,648	17,798	255		37,401	219,500	90,530	2,296,808
Fippenies Bank	2,235	50,465	501					4,645	289,271
Platts Bank	18,102	59,613	876	1,315			23,700	36,212	710,504
Jeffreys Ledge	390,478	237,602	2,208	10,282		1,372,105	21,000	246,125	5,274,506
Ipswitch Bay						53,110			53,110
Middle Bank (Stellwagen Bank)	41,085	126,635	1,652	19,275		7,310		5,530	1,842,324
South						971,175		4,000	975,175
Shore, general	5,609,151	131,397	11,054	2,367,730	50,093	19,410,114	718,900	1,098,709	38,719,484
Total	10,430,395	3,258,044	1,171,746	10,737,950	4,517,137	36,939,890	1,037,850	2,703,561	313,509,298
Grand total	10,567,490	3,493,523	2,696,308	10,787,765	4,592,962	37,821,190	6,315,090	2,770,741	329,977,722

NOTE.—The weight of salt fish landed has been converted to the equivalent of fresh fish as landed.

Days' absence from port of fishing vessels landing fish at Boston and Gloucester, Mass., and Portland, Me., 1929

Fishing grounds	January	February	March	April	May	June	July
Off Newfoundland:							
Grand Bank		19	21	64	43	144	233
Green Bank				24			
St. Peters Bank		43	76		31		
Bay of Islands	144	33					
Off Newfoundland						45	
Total	144	95	97	88	74	189	233
Off Canada:							
Seal Island Ground							
Labrador Coast						84	
Gulf of St. Lawrence						126	30
Scatari Bank						33	
Quereau Bank						20	
The Gully			20	26			
Sable Island Bank (Western Bank)				20	73	103	140
Cape Shore	24				50	126	20
La Have Bank		17		21	53	67	27
Total	24	17	20	67	176	559	217
Off United States:							
Brown Bank	287	273	331	354	227	76	260
Georges Bank	1,769	1,656	1,901	1,919	1,934	2,245	3,192
Clark Bank			6				
South Channel	888	778	597	458	372	855	1,863
Off Highland Light							4
Off Chatham	42	118	78	54	27	12	96
Nantucket Shoals	57	110	64	75	124	85	76
Cashes Bank	30	18		26	50	35	7
Fippenies Bank	5	6		3	18		
Platts Bank	12	3				6	
Jeffreys Ledge	80	169	143	37	8	32	20
Ipswitch Bay						13	
Middle Bank (Stellwagen Bank)	108	26	5				
South				4	186	27	
Shore, general	299	589	805	730	742	994	498
Total	3,577	3,746	3,930	3,660	3,688	4,380	6,016
Grand total	3,745	3,858	4,047	3,815	3,938	5,128	6,466

Fishing grounds	August	September	October	November	December	Total
Off Newfoundland:						
Grand Bank	120	22				666
Green Bank		27	47			98
St. Peters Bank						150
Bay of Islands					203	380
Off Newfoundland						45
Total	120	49	47		203	1,339
Off Canada:						
Seal Island Ground					2	2
Labrador Coast						84
Gulf of St. Lawrence						156
Scatari Bank						33
Quereau Bank			31			51
The Gully						46
Sable Island Bank (Western Bank)	19				10	365
Cape Shore	33	167	58	33	39	550
La Have Bank	46	62	7	67	380	747
Total	98	229	96	100	431	2,034
Off United States:						
Brown Bank	120	170	45	94	213	2,450
Georges Bank	2,699	1,811	1,418	869	1,340	22,753
Clark Bank			14	23		43
South Channel	1,445	1,169	1,723	1,949	1,086	13,183
Off Highland Light						4
Off Chatham	630	10	7		42	1,116
Nantucket Shoals	86	203	195	324	291	1,690
Cashes Bank	7	3	29	72	119	396
Fippenies Bank			2	10	4	48
Platts Bank		5	59	36	6	127
Jeffreys Ledge	137	185	95	83	76	1,065
Ipswitch Bay						13
Middle Bank (Stellwagen Bank)	3	17	80	110	84	433
South						217
Shore, general	412	1,170	840	1,309	581	8,969
Total	5,539	4,743	4,507	4,879	3,842	52,507
Grand total	5,757	5,021	4,650	4,979	4,476	55,880

MACKEREL FISHERY OF THE ATLANTIC COAST

The mackerel fishery of the Atlantic Coast of the United States had been declining from 1926 to 1928, but in 1929 there was a sharp recovery. The total catch was over 46,000,000 pounds as compared with less than 31,000,000 in 1928. The gain was due to the incoming of a new year-class, which furnished nearly 21,000,000 pounds of small mackerel. In general, fewer vessels participated regularly in the fishery during 1929 than during the previous year. The more remarkable differences as compared with last year were: A poor seining season and a more successful gill-net season in the south, a tremendous run of small mackerel off New England in August and September and the virtual failure of fall netting out of Gloucester.

Statistical summaries appear in the accompanying tables. As heretofore, only the purse seine and drift gill-net fisheries have been included. They have been designated as "seiners" and "netters," respectively. Because of their importance in certain seasons boats under 5 tons and operating purse seines or gill nets have been included in so far as data were available. The catch of shore gear, such as pound nets and traps were omitted. Practically all of the statistics were collected by the bureau's agents at Cape May, N. J., New York City, Boston, Gloucester, and Woods Hole, Mass., and Portland, Me. A few data on landings, particularly at ports not having a bureau representative, were secured from unofficial sources and consist of estimated, rather than "weighed-out" fares. The error involved is probably well under 5 per cent in the vessel fishery. The figures on the boat fishery are probably less complete. The small fish have been enumerated separately from the medium and large. The term "small" refers to mackerel one-half or three-fourths pound in weight. The catch of bullseye mackerel, *Scomber colias*, was not included. It amounted to 54,170 pounds in 1929, as compared with 935,675 the previous year.

Southern fishery.—This includes the catch of mackerel in waters off New York, New Jersey, Delaware, Maryland, and Virginia. The area is bounded on the east by longitude 72° W., which passes through the eastern end of Long Island about 9 miles west of Montauk Point.

Most of the vessels participating in this fishery sailed south from Gloucester during the last week in March and the first week in April, and the first catch was made by seiners on April 7 and landed at Cape May, N. J., on April 8. Seining operations continued in this area until May 28.

Unfavorable weather persisted during such a large portion of the season that only 26 vessels remained in the fishery during the entire period; 28 others participated part of the time and altogether the seining fleet took 3,233,521 pounds, as compared with 6,192,739 in the previous year.

Netters operated in the southern waters from April 21 to May 31. They were relatively more successful than were the seiners. In general, fair weather prevailed during the full moon periods when gill netting is mostly pursued. This, together with the participation of more vessels, produced a catch of 2,952,938 pounds, as compared with 1,215,937 pounds in the previous year.

Block Island fishery.—This includes the operations off southern New England between longitude 72° W., near Montauk Point on the eastern end of Long Island, and a line drawn 145° from true north from Sankaty Head, Nantucket.

The seiners shifted from the south to this region about May 26. Most of them pulled out by June 20, though a few continued until a week longer. During this time 32 vessels fished regularly in this area and, together with 30 other vessels, caught 3,004,270, as compared with 8,385,406 pounds caught by seiners during the previous year.

During the summer there were occasional trips of mackerel caught in this area by seiners. Altogether, nine such trips, aggregating 39,800 pounds, were landed.

The netters operated in this area from about May 26 to June 17, catching, 246,860 pounds of mackerel, as compared with 469,119 the previous year.

Gulf of Maine.—This includes all of the waters from Nantucket Shoals to Nova Scotia. Most of the mackerel fishing was done in the offing of Cape Cod, in Massachusetts Bay, and around Seguin Island, Me.

Seiners began fishing in this region during the early part of June; most of them landed their first trips between June 10 and 30. During June, July, and August most of the fishing was done in the offing of Cape Cod, where large mackerel predominated, particularly on the northwest edge of Georges Bank and the north end of South Channel. In July small mackerel of about one-half pound each began to appear in catches from along the outer shores of Cape Cod, and by the end of August these dominated in the catch. In the early part of September the fishery shifted to Massachusetts Bay and along the coast of Maine in the vicinity of Seguin Island. Except for a few large mackerel which continued to come from northern Georges, practically the entire catch was of small mackerel. During October the catches consisted entirely of small mackerel, most of them from Cape Cod Bay. The season ended earlier than usual; most of the seiners had landed their last trips by October 28.

All told, there were 103 seiners operating in the Gulf of Maine sector in 1929; 51 of these fished regularly throughout the whole season. The catch consisted of 14,325,209 pounds of large mackerel and 20,746,813 of small mackerel, a total of 35,071,022 pounds as compared with 11,924,679 in 1928.

The netters had a short spring season in the Gulf of Maine, between May 25 and June 20, landing 165,312 pounds.

The fall netting season was disappointing. Although 91 vessels and boats participated, 38 of them regularly, and fished from October 20 to December 11, only 566,712 pounds were landed, as compared with 1,945,929 the previous year.

Cape Shore fishery.—Eleven seiners made 15 trips to the offing of Nova Scotia during the early part of June. The total catch from this region was 884,900 pounds, as compared with 313,210 the previous year.

Mackerel fishery of the Atlantic coast, 1929

BY PORTS, IN 5-DAY PERIODS [1]

Date	Cape May, Wildwood, Atlantic City	New York	Newport, New Bedford, Woods Hole, Provincetown	Boston	Gloucester	Portland	Total
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Apr. 6–10	269,078						269,078
Apr. 11–15	114,793	40,000					154,793
Apr. 16–20	1,625						1,625
Apr. 21–25	68,083						68,083
Apr. 26–30	496,718	250,000		40,000			786,718
May 1–5	245,640	575,750					821,390
May 6–10	172,395	706,364	21,000				899,759
May 11–15	50,500	621,695	160,100	333,375	40,690		1,206,360
May 16–20		713,868		22,645	33,110		769,623
May 21–25		355,350	152,510	31,740			539,600
May 26–31		151,400	416,490	261,250	62,190	8,800	900,130
June 1–5		21,000	145,150	530,385	17,442		713,977
June 6–10		50,500	26,350	1,146,515	20,560	4,610	1,248,535
June 11–15		10,000	148,210	849,210	189,130	1,315	1,197,865
June 16–20			46,050	636,850	316,540	766	1,000,206
June 21–25			65,560	657,195	122,710		845,465
June 26–30			73,900	1,184,070	535,560		1,793,530
July 1–5			[2] 9,200	1,294,400	1,564,880	127,678	2,996,158
July 6–10				625,195	85,170	36,270	746,635
July 11–15				1,642,985	658,560	112,280	2,413,825
July 16–20				450,985	123,100	1,645	575,730
July 21–25			[2] 4,500	685,495	459,855	57,280	1,207,130
July 26–31			[2] 8,000	860,045	221,720	12,389	1,102,154
Aug. 1–5			[2] 22,000	431,840	290,610	58,920	803,370
Aug. 6–10			[3] 14,000	1,148,004	339,250	31,744	1,532,998
Aug. 11–15				615,490	436,550	9,280	1,061,320
Aug. 16–20			[3] 16,000	620,598	975,444	28,008	1,640,050
Aug. 21–25			[3] 108,000	344,215	844,800	20,969	1,317,984
Aug. 26–31			[2] 8,000	391,315	416,840	82,508	898,663
Sept. 1–5				327,190	953,760	303,210	1,584,160
Sept. 6–10			[3] 10,000	190,960	1,382,740	240,295	1,823,995
Sept. 11–15			[2] 57,200	304,910	377,675	97,065	836,850
Sept. 16–20			[3] 28,400	801,679	1,446,250	[4] 347,628	2,623,957
Sept. 21–25			[2] 20,000	1,022,990	1,548,300	266,819	2,858,109
Sept. 26–30			[3] 379,000	1,546,655	1,099,810	126,825	3,152,290
Oct. 1–5				26,000	13,800	36,960	76,760
Oct. 6–10			[2] 72,000	766,020	158,794	240	997,054
Oct. 11–15			[3] 8,000	698,805	110,576	47,500	864,881
Oct. 16–20				36,935	12,990	2,850	52,775
Oct. 21–25				674,120	164,545	7,745	846,410
Oct. 26–31				439,478	34,679		474,157
Nov. 1–5					31,452		31,452
Nov. 6–10				4,117	94,371		98,488
Nov. 11–15				19,500	242,785		262,285
Nov. 16–20				17,455	30,128		47,583
Nov. 21–25					1,742		1,742
Nov. 26–30					15,077		15,077
Dec. 1–5					5,490		5,490
Dec. 6–10					50		50
Dec. 11–15					26		26
Total	1,418,832	3,495,927	2,019,620	21,680,616	15,479,751	2,071,599	46,166,345

[1] The landings at the ports of Boston, Gloucester, and Portland vary somewhat from those published under "Vessel Fisheries at Principal New England Ports," due to the inclusion of landings of some small boats in the above data, and also to different methods in the collection of the statistics.
[2] Landed at Provincetown.
[3] Landed at Provincetown and Noank, Conn.
[4] Includes 20,000 pounds landed at Boothbay, Me.

Mackerel fishery of the Atlantic coast, 1929—Continued

OPERATING UNITS: BY FLEET CLASSIFICATION AND GROUNDS

Designation	Vessels and boats	Tonnage	Crew	Trips	Catch: Medium and large	Catch: Small	Catch: Total
SOUTHERN	*Number*	*Net tons*	*Number*	*Number*	*Pounds*	*Pounds*	*Pounds*
Seiners:							
Regular vessels	26	1,235	331	148	2,273,824	11,805	2,285,629
Miscellaneous vessels	28	1,208	344	76	921,412	1,480	922,892
Miscellaneous boats	1			1	25,000		25,000
Netters:							
Regular vessels	37	643	235	293	2,452,356	9	2,452,365
Miscellaneous vessels	17	211	91	53	249,208		249,208
Miscellaneous boats	16			39	251,375		251,375
Total	[1] 123			610	6,173,175	13,294	6,186,469
BLOCK ISLAND							
Seiners:							
Spring—							
Regular vessels	32	1,116	381	125	2,301,985	42,925	2,344,910
Miscellaneous vessels	30	1,147	341	46	644,650	14,710	659,360
Sumner and fall—							
Miscellaneous vessels	8	231	76	8	17,750	17,400	35,150
Miscellaneous boats	1			1	4,650		4,650
Netters:							
Spring—							
Miscellaneous vessels	22	283	115	36	188,320		188,320
Miscellaneous boats	10			14	58,540		58,540
Total	[1] 101			230	3,215,895	75,035	3,290,930
GULF OF MAINE							
Seiners:							
Regular vessels	51	1,753	591	1,029	11,890,854	16,440,462	28,331,316
Miscellaneous vessels	50	1,323	446	360	2,419,855	4,281,551	6,701,406
Miscellaneous boats	2			4	14,500	24,800	39,300
Netters:							
Spring—							
Miscellaneous vessels	18	259	106	44	121,702		121,702
Miscellaneous boats	11			31	43,610		43,610
Fall—							
Regular vessels	38	872	269	347	366,185		366,185
Miscellaneous vessels	37	858	248	159	159,593		159,593
Miscellaneous boats	16			96	40,934		40,934
Total	[1] 156			2,070	15,057,233	20,746,813	35,804,046
CAPE SHORE							
Seiners	11	678	153	15	884,900		884,900
Total seiners	[2] 105			1,813	21,399,380	20,835,133	42,234,513
Total netters	[3] 148			1,112	3,931,823	9	3,931,832
Grand total	[4] 304			2,925	25,331,203	20,835,142	46,166,345

[1] Exclusive of duplication.
[2] Exclusive of duplication, inclusive of 4 boats of less than 5 net tons.
[3] Exclusive of duplication, inclusive of 48 boats of less than 5 net tons.
[4] Exclusive of duplication, inclusive of 51 boats of less than 5 net tons.

Landings of mackerel 1905–1929

Year	Pounds [1]	Year	Pounds [1]
1905	15, 398, 070	1918	13, 915, 200
1906	8, 106, 960	1919	9, 990, 690
1907	16, 902, 270	1920	13, 292, 040
1908	14, 376, 990	1921	6, 923. 790
1909	11, 702, 190	1922	8, 797, 680
1910	3, 909, 150	1923	23, 390, 580
1911	8, 322, 060	1924	18, 237, 120
1912	7, 011, 240	1925	33, 953, 490
1913	9, 327, 330	1926	47, 126, 100
1914	14, 477, 970	1927	41, 998, 600
1915	16, 051, 170	1928	30, 983, 880
1916	20, 642, 580	1929	46, 166, 345
1917	25, 473, 540		

[1] Represents the weight of mackerel landed in the round plus the weight of mackerel landed salted which has been converted to the equivalent of fresh mackerel in the round.

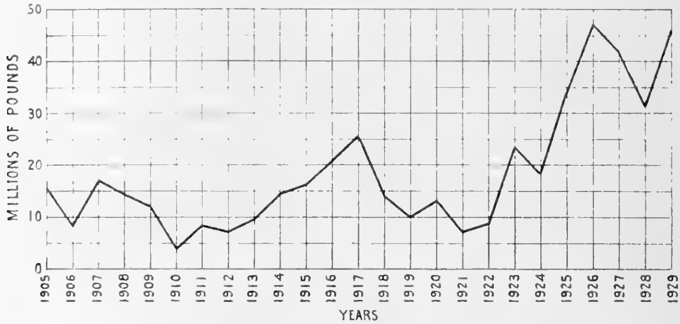

FIGURE 18.—Catch of mackerel in the North Atlantic fishery, 1905 to 1929

FISHERIES OF THE MIDDLE ATLANTIC STATES

The latest statistical canvass of the fisheries and fishery industries of the Middle Atlantic States (New York, New Jersey, Pennsylvania, and Delaware), was for the calendar year 1926. The complete statistics for this canvass are published in the report of the division of fishery industries for 1927 and in condensed form in Statistical Bulletin No. 786.

During 1926 the fisheries and fishery industries of the Middle Atlantic States gave employment to 14,335 persons, of whom 9,953 were fishermen, 107 were engaged in the transporting trade, 3,412 were in the wholesale trade, and 843 in the canning and by-products industries. The catch of the fisheries of these States amounted to 168,012,495 pounds, valued at $12,456,256. The products of the canning, salting, smoking, and by-products industries had a value of $4,018,488.

Fisheries of the Middle Atlantic States, 1926

CATCH: BY STATES

Products	New York		New Jersey		Pennsylvania		Delaware		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
FISH										
Albacore	16, 800	$668	18, 268	$665					35, 068	$1, 333
Alewives	1, 564, 415	25, 594	379, 550	12, 584	5, 300	$165	546, 050	$8, 704	2, 495, 315	47, 047
Bluefish	261, 740	60, 381	628, 241	148, 147	21, 400	4, 850	10, 300	2, 952	921, 681	216, 330
Bonito	90, 205	4, 910	507, 660	40, 756	400	40			598, 265	45, 706
Butterfish	998, 135	84, 313	3, 078, 247	235, 293	6, 000	300	6, 320	344	4, 088, 702	320, 250
Carp	207, 100	27, 636	279, 039	50, 024	3, 875	800	109, 548	15, 168	599, 562	93, 628
Catfish and bullheads	23, 567	3, 981	136, 226	10, 935	5, 600	505	55, 617	3, 525	221, 010	18, 946
Cod	2, 642, 961	123, 555	2, 216, 691	109, 065	14, 287	817			4, 873, 939	233, 437
Cod roe	40	4							40	4
Croaker	4, 000	120	2, 455, 867	104, 827	1, 000	40	897, 100	24, 256	3, 357, 967	129, 243
Drum, black	200	2	31, 100	909			4, 240	73	35, 540	984
Drum, red	100	2	14, 300	412			3, 310	60	17, 710	474
Eels	516, 394	70, 543	251, 671	25, 392	2, 500	375	52, 040	8, 043	822, 605	104, 353
Flounders	7, 532, 138	396, 707	2, 921, 714	209, 314	400	26	66, 040	3, 439	10, 520, 292	609, 486
Grayfish	2, 115	69	4, 640	278					6, 755	347
Haddock	17, 019, 780	597, 276	3, 450	156					17, 023, 230	597, 432
Hake	175, 845	6, 966	451, 320	9, 497					627, 165	16, 463
Halibut	10, 381	3, 489							10, 381	3, 489
Herring	2, 407	40	235, 665	7, 030					238, 072	7, 070
Hickory shad	13, 147	586	5, 439	219					18, 586	805
King whiting or "kingfish"	63, 861	10, 599	33, 125	4, 664			4, 250	406	101, 236	15, 669
Mackerel	740, 299	52, 579	2, 165, 752	141, 147	39, 847	2, 284			2, 945, 898	196, 010
Menhaden	11, 224, 870	44, 759	5, 378, 807	20, 945	36, 000	240	23, 251, 560	96, 380	39, 891, 237	162, 324
Minnows	8, 033	4, 598							8, 033	4, 598
Mullet	750	21	6, 000	500			22, 250	972	29, 000	1, 493
Mummichog	9, 075	620							9, 075	620
Pike or pickerel	327	98					500	75	827	173
Pilotfish	225	10	3, 900	125					4, 125	135
Pollock	102, 463	5, 057	23, 310	1, 244					125, 773	6, 301
Pompano	116	12	625	243					741	255
Scup or porgy	927, 493	88, 553	2, 452, 079	126, 397	122, 400	5, 520	2, 000	160	3, 503, 972	220, 630
Sea bass	231, 125	29, 385	2, 095, 857	171, 606	42, 800	3, 574			2, 369, 782	204, 565
Sea robin	30, 084	572	23, 100	684					53, 184	1, 256
Shad	231, 392	49, 212	552, 480	139, 564	20, 766	5, 322	147, 095	39, 621	951, 733	233, 719
Sharks	15, 763	408	48, 710	1, 365					64, 473	1, 773
Silversides or spearing	61, 200	2, 715	2, 000	2, 000					63, 200	4, 715
Skates	40, 240	1, 207	47, 446	1, 331					87, 686	2, 538
Smelt	180	44							180	44
Spanish mackerel	37	9	13, 992	1, 804					14, 029	1, 813
Spot	436, 484	26, 084	1, 217, 704	75, 972			103, 900	6, 439	1, 758, 088	108, 495

Fisheries of the Middle Atlantic States, 1926—Continued

CATCH: BY STATES—Continued

Products	New York		New Jersey		Pennsylvania		Delaware		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
FISH—continued										
Squeteagues or weakfish	1,073,211	$98,544	7,172,685	$448,198	383,000	$15,440	771,880	$38,812	9,400,776	$600,994
Striped bass	86,550	20,984	64,159	18,470			46,347	8,916	197,056	48,370
Sturgeon	8,946	1,682	7,400	2,248			5,580	2,561	21,926	6,491
Sturgeon roe	80	22	490	740			891	922	1,461	1,684
Suckers	72,493	9,505	92,675	14,975	26,000	2,858	2,600	118	193,768	27,456
Swellfish	12,900	390							12,900	390
Swordfish	60,809	11,391							60,809	11,391
Tautog	48,312	4,393	21,729	1,700	200	16	12,000	600	82,241	6,709
Thimble-eyed mackerel	16,890	1,166	105,038	3,498					121,928	4,664
Tilefish	1,801,750	111,500							1,801,750	111,500
Tomcod or frostfish	53,512	2,387	1,100	72					54,612	2,459
Tomcod roe	3,000	250							3,000	250
Tuna or horse mackerel	11,942	1,959	132,420	9,544					144,362	11,503
White bait	18,100	1,200							18,100	1,020
White perch	20,061	2,570	113,035	15,885			64,944	5,313	198,040	23,768
Whiting	583,054	13,600	6,935,124	142,243	2,500	15			7,520,678	155,858
Yellow perch	14,328	1,926	27,000	5,075			23,106	2,111	64,434	9,112
Miscellaneous fish	560,751	4,798	63,206	5,888			156	10	629,113	10,696
Total	49,652,176	2,011,651	42,425,036	2,323,630	734,275	43,187	26,209,624	269,980	119,021,111	4,648,448
SHELLFISH, ETC.										
Crabs:										
Hard	2,000	100	61,566	5,825			166,842	7,702	230,408	13,627
Soft	979	535	6,400	4,100			155,820	43,950	163,199	48,585
King			2,248,000	10,856			640,000	1,600	2,888,000	12,456
Lobsters	455,218	130,716	643,286	193,649			20,640	6,202	1,119,144	330,567
Shrimp	6,400	2,400	36,276	1,758					[1] 42,676	4,158
Squid	539,563	35,310	1,036,264	64,627					1,575,827	99,937
Clams, hard:										
Public	518,152	248,912	613,864	297,470			4,736	2,860	1,136,752	549,242
Private	68,888	42,484	23,384	12,000			48,256	21,864	140,528	76,348
Clams, soft	264,220	56,046	144,600	25,350					408,820	81,396
Skimmers or surf clams	59,112	15,436							59,112	15,436
Mussels	210,000	10,200	47,000	560					257,000	10,760
Oysters, market:										
Public	5,950	1,025	67,424	12,563			826,560	41,010	899,934	54,598
Private	7,119,315	2,110,697	11,137,721	2,033,991			2,585,205	435,020	20,842,241	4,579,708
Oysters, seed:										
Public	214,550	39,125	14,650,447	1,243,918			2,586,920	197,740	17,451,917	1,480,783
Private	224,000	49,600	93,100	6,740					317,100	56,340

Scallops:										
Bay	299,892	92,253							299,892	92,253
Sea	1,067,964	267,938	47,436	15,688					1,115,400	283,626
Frogs							1,800	450	1,800	450
Terrapin							1,080	750	1,080	750
Turtles	490	15	17,319	1,539	500	100	10,245	834	28,554	2,488
Miscellaneous products (for bait)	12,000	14,300							12,000	14,300
Total	11,068,693	3,117,092	30,874,087	3,930,634	500	100	7,048,104	759,982	48,991,384	7,807,808
Grand total	60,720,869	5,128,743	73,299,123	6,254,264	734,775	43,287	33,257,728	1,029,962	168,012,495	12,456,256

[1] Taken mostly off the coast of Florida.

NOTE.—The above statistics do not include any fisheries of the Great Lakes or other inland waters.

CATCH: BY YEARS

[Expressed in thousands of pounds and thousands of dollars; that is, 000 omitted]

Year	New York		New Jersey		Pennsylvania		Delaware		Total	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
1880	329,453	4,226	65,151	3,176	1,680	277	11,918	998	408,202	8,677
1887	130,288	3,387	65,246	4,168	7,895	333	10,396	211	213,825	8,099
1888	192,513	3,466	61,115	4,199	12,901	344	10,226	209	276,755	8,218
1889	175,936	4,182	82,362	3,170	7,166	325	9,859	257	275,323	7,934
1890	192,471	4,602	88,730	3,447	7,849	328	10,054	267	299,104	8,644
1891	170,885	4,817	79,116	3,520	7,584	322	7,698	255	265,283	8,914
1892	(2)	(2)	73,267	3,646	6,324	284	7,195	251		
1897	109,556	3,392	103,782	3,614	5,604	269	8,648	252	227,590	7,527
1898	210,497	3,545	90,297	3,564	(2)	(2)	(2)	(2)		
1901	228,092	3,894	117,931	4,756	6,030	251	5,835	203	357,888	9,104
1904	277,650	6,231	90,108	3,385	2,046	167	5,608	260	375,412	10,043
1908	71,474	4,390	74,827	3,069	4,380	280	70,769	541	221,450	8,280
1921	210,377	4,987	96,937	5,983	595	45	25,023	652	332,932	11,667
1926	60,721	5,129	73,299	6,254	735	43	33,258	1,030	168,013	12,456

[2] Statistics not available.

VESSEL FISHERIES OF NEW YORK CITY AND GROTON, CONN. [4]

During 1929 fishing vessels of 5 net tons and over landed 75,325,000 pounds of fishery products at New York City and Groton, Conn. This is 6 per cent more than in 1928 and about four times the landings during 1922, the first year for which there is a complete record. Most of the ground fish were taken with otter trawls.

Species landed.—The increase in the landings of fish at these ports during the past few years has been due mainly to the greater quantity of haddock landed. In 1929 the landings of this species amounted to 55,937,000 pounds, or 74 per cent of the total. This is about thirteen times the landings of this species in 1922. Most of these haddock are utilized by fish-packing plants in preparing package fish products. Next in volume were flounders with landings of 7,374,000

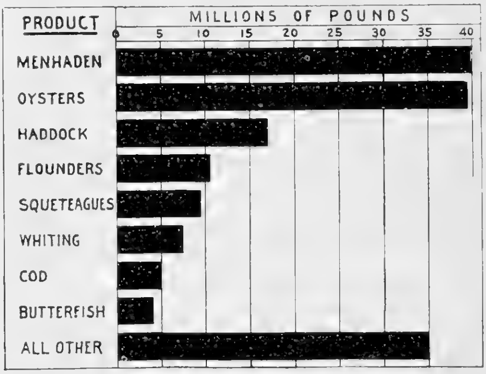

FIGURE 19.—Yield of principal fishery products in the Middle Atlantic States, 1926

pounds, or 10 per cent of the total. This is slightly less than a year ago. Cod ranked third in 1929 with landings of 4,458,000 pounds, or 6 per cent of the total. Mackerel were fourth in importance, with landings of 3,286,000 pounds, or 4 per cent of the total. This is less than was landed in 1928. Tilefish, a species common almost exclusively to these ports, were fifth, with landings of 2,458,000 pounds, or 3 per cent of the total. This was slightly more than in the previous year. The landings of all other species amounted to about 2 per cent of the total.

[4] Statistics of the landings of fish by vessels of 5 net tons and over at New York City have been collected during the past few years by J. H. Matthews, executive secretary, Middle Atlantic Fisheries Association. These have been forwarded to the bureau, where they have been compiled.
Since November, 1927, statistics of the landings of fish by vessels at Groton, Conn., have been included with those for fish landed at New York City, because at that time one of the firms packing fish at New York City moved its plant to Groton, thus requiring the trawlers to unload at Groton. By including the landings at Groton, the figures since November, 1927, are comparable with those for previous years. The statistics at both ports are combined to avoid disclosing individual enterprise.

Landings of fish at New York City and Groton, Conn., 1922 to 1929 [1]

[Expressed in thousands of pounds; that is, 000 omitted]

Year	Bluefish	Cod	Flounders	Haddock	Hake	Halibut	Mackerel	Pollock
1922	2,032	936	5,550	4,332			1,371	
1923	1,735	1,394	9,614	10,792			1,251	
1924	111	1,686	13,281	[3] 14,449			3,047	
1925	51	1,647	17,912	14,771		73	2,670	
1926	74	1,282	12,793	17,908		54	5,038	
1927	71	1,426	10,076	30,403		40	4,939	
1928	143	2,970	9,979	49,990	215	59	3,850	183
1929	476	4,458	7,374	55,937	140	60	3,286	120

Year	Porgies or scup and sea bass	Sturgeon	Swordfish	Tilefish	Squeteague or weakfish	Miscellaneous [2]	Total
1922	1,583	20	2	1,153	59	3,716	20,754
1923	2,553			1,364	272	4,857	33,832
1924	808			1,262	332	45	35,021
1925	1,318			1,015	1,099	66	40,622
1926	540			1,975	228	42	39,934
1927	459			2,777	171	410	50,772
1928	622		22	2,365	16	763	71,177
1929	686			2,458	84	246	75,325

[1] Includes landings of fish at Groton, Conn., beginning with November, 1927.
[2] Where landings are not shown for certain species, it is probable that they are included under "miscellaneous."
[3] Includes the landings of some mixed fish.

SHAD FISHERY OF THE HUDSON RIVER

Shad fishing in the Hudson River in 1929 was followed by 241 fishermen who used 94 row boats, 30 motor boats, 104 drift gill nets that had a total area of 355,477 square yards, and 15 stake gill nets that had an area of 41,008 square yards. The catch amounted to 56,480 shad, having a weight of 196,745 pounds, and a value to the fishermen of $30,683. This is a decrease of 29 per cent in both number and value as compared with the production in 1928. There was a decline of nearly 2 cents per pound from the price received by the fishermen in 1928.

More than 75 per cent of the catch was taken with drift gill nets, the remainder being taken with stake gill nets. The former were universally used on the river above Haverstraw, while from that point south, stake gill nets were used exclusively.

With the exception of some fishing with stake gill nets from one town in New Jersey, the fishing was prosecuted entirely in New York waters.

Most of the shad were disposed of locally by the fishermen, either directly to the consumer on the shore or by peddling, or to local markets and buyers. Very few were shipped to New York City, except from a few near-by towns, as the prices prevailing in that city did not justify it.

Shad fishery of the Hudson River, 1929

Items	New York			New Jersey			Total		
	Number	*Pounds*	*Value*	*Number*	*Pounds*	*Value*	*Number*	*Pounds*	*Value*
Fishermen	224			17			241		
Rowboats	88			6			94		
Motor boats	27			3			30		
Gill nets, drift	104						104		
Square yards	355,477						355,477		
Gill nets, stake	10			5			15		
Square yards	31,908			9,100			41,008		
Shad caught:									
With drift gill nets	43,430	149,328	$24,547				43,430	149,328	$24,547
With stake gill nets	2,550	8,567	1,254	10,500	38,850	$4,882	13,050	47,417	6,136
Total	45,980	157,895	25,801	10,500	38,850	4,882	56,480	196,745	30,683

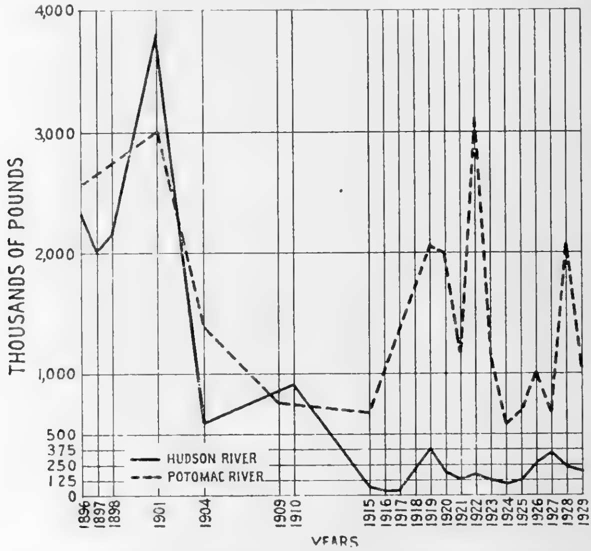

FIGURE 20.—Catch of shad in the Hudson and Potomac Rivers for various years, 1896 to 1929

Catch of shad in the Hudson River for various years, 1896 to 1929

Year	New York			New Jersey			Total		
	Number	*Pounds*	*Value*	*Number*	*Pounds*	*Value*	*Number*	*Pounds*	*Value*
1896	420,098	1,681,371	$58,921	168,800	675,595	$24,316	588,898	2,356,966	$83,237
1897	401,877	1,506,142	49,353	115,200	529,920	17,934	520,077	2,036,062	67,287
1898	410,395	1,534,877	50,875	129,855	606,423	18,510	540,250	2,141,300	69,385
1901	829,612	3,202,302	100,762	144,315	577,260	21,647	973,927	3,779,562	122,409
1904	100,624	402,496	28,896	57,657	201,800	17,758	158,281	604,296	46,654
1910 [1]	126,534	506,136	51,715	101,720	406,880	49,109	228,254	913,016	100,824
1915	11,606	48,564	5,969	4,249	20,104	2,674	15,855	68,668	8,643
1916	7,787	32,923	4,540	1,500	7,250	925	9,287	40,173	5,465
1917	10,615	38,344	5,810	1,400	5,040	720	12,015	43,384	6,530
1918	63,404	220,602	44,784	3,999	14,000	3,400	67,403	234,602	48,184
1919	76,501	301,306	60,690	13,800	73,668	23,034	90,301	374,974	83,724
1920	39,692	157,715	43,882	9,623	42,129	12,427	49,315	199,844	56,309
1921	28,948	104,883	24,329	6,500	25,920	6,294	35,448	130,803	30,623
1922	36,111	128,324	27,451	12,225	46,862	12,255	48,336	175,186	39,706
1923	28,636	97,863	22,644	6,450	23,865	6,000	35,086	121,728	28,644
1924	22,814	72,519	17,619	5,980	21,850	5,485	28,794	94,369	23,104
1925	34,568	110,359	24,030	4,300	13,975	2,400	38,868	124,334	26,430
1926	73,312	219,183	47,175	11,150	46,237	6,300	84,462	265,420	53,475
1927	89,984	299,693	56,950	20,300	58,362	6,700	110,284	358,055	63,650
1928	61,079	194,181	32,689	17,950	52,050	10,460	79,029	246,231	43,149
1929	45,980	157,895	25,801	10,500	38,850	4,882	56,480	196,745	30,683

[1] Includes catch in lower New York Bay, Raritan Bay and tributaries, but this was inconsiderable.

FISHERIES OF THE CHESAPEAKE BAY STATES

The latest statistical canvass of the fisheries and fishery industries of the Chesapeake Bay States (Maryland and Virginia) was for the calendar year 1925. Complete statistics are published in the report of the division of fishery industries for 1926 and in condensed form in Statistical Bulletin No. 745.

During 1925 the fisheries and fishery industries of Maryland and Virginia gave employment to 39,091 persons, of whom 25,856 were engaged in fishing operations, 9,671 in the wholesale fishery trade, and 3,564 in the canning, salting, smoking, and by-products industries. The products of the fisheries of the two States amounted to 333,205,769 pounds, valued at $13,948,060. The products of the canning and other fishery industries had a value of $4,936,664.

Fisheries of the Chesapeake Bay States, 1925

Products	Maryland		Virginia		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh	7,480,114	$78,502	17,886,647	$208,953	25,366,761	$287,455
Alewives, salted	200,400	4,582	23,600	770	224,000	5,352
Alewives, smoked	20,400	1,200			20,400	1,200
Amberfish			350	18	350	18
Anglefish			4,050	225	4,050	225
Black bass	35,609	6,760	57,418	7,734	93,027	14,494
Bluefish	57,743	7,803	157,258	18,858	215,001	26,661
Bonito	16,300	925	288,110	15,891	304,410	16,816
Bowfin			24,775	753	24,775	753
Butterfish	276,575	15,694	5,836,357	252,298	6,112,932	267,992
Carp	198,353	16,698	462,419	30,997	660,772	47,695
Catfish	474,719	26,005	534,330	32,057	1,009,049	58,062
Cobia or coalfish			3,260	265	3,260	265
Cod			17,000	406	17,000	406
Croaker	2,602,861	63,326	22,649,295	648,090	25,252,156	711,416
Drum, black	25,150	472	228,180	3,529	253,330	4,001
Drum, red, or redfish	4,160	107	125,390	2,243	129,550	2,350
Eels, fresh	197,862	23,423	181,948	21,900	379,810	45,323
Eels, salted	67,200	8,064			67,200	8,064
Flounders	118,078	7,704	581,817	37,902	699,895	45,606
Gizzard shad	31,025	973	350,283	8,785	381,308	9,758
Goldfish	400	20	2,600	129	3,000	149
Haddock			2,000	80	2,000	80
Hake			11,800	232	11,800	232
Harvestfish	3,700	428	[1] 743,770	26,864	747,470	27,292
Hickory shad	20,561	1,132	235,127	11,034	255,688	12,166
Hog-chokers, salted	23,525	1,379			23,525	1,379
Hogfish			1,348	128	1,348	128
King whiting	3,600	424	122,838	8,919	126,438	9,343
Mackerel	9,460	980	11,840	1,234	21,300	2,214
Menhaden	7,000	25	150,485,623	1,434,681	150,492,623	1,434,706
Mullet	14,509	999	122,072	8,161	136,581	9,160
Pigfish	1,000	34	139,451	7,430	140,451	7,464
Pike	71,691	16,456	17,855	2,983	89,546	19,439
Pinfish			1,400	130	1,400	130
Pompano	250	70	4,584	1,003	4,834	1,073
Scup or porgy	45,000	3,100	402,274	27,928	447,274	31,028
Sea bass	54,700	3,788	51,340	4,568	106,040	8,356
Sea robin			50,000	71	50,000	71
Shad	1,260,152	264,388	6,103,704	1,372,491	7,363,856	1,636,879
Sharks			17,154	1,021	17,154	1,021
Sheepshead			122	17	122	17
Skates			23,600	148	23,600	148
Spanish mackerel	290	65	127,445	16,679	127,735	16,744
Spot	208,377	11,485	1,768,206	88,090	1,976,583	99,575
Squeteagues, or "sea trout"	1,480,209	88,733	12,444,450	579,563	13,924,659	668,296
Striped bass	1,413,999	240,388	821,309	151,027	2,235,308	391,415
Sturgeon	19,225	4,321	65,977	16,167	85,202	20,488
Sturgeon caviar and roe	2,500	2,500	5,353	5,752	7,853	8,252
Suckers	3,775	155	4,113	250	7,888	405
Sunfish	7,733	322	400	20	8,133	342
Swellfish			35,000	49	35,000	49
Tautog	400	24	2,870	225	3,270	249
Thimble-eyed mackerel	5,000	100	13,700	428	18,700	528
Tomcod	800	25	17,400	420	18,200	445

[1] Of the amount 701,445 pounds, valued at $25,376 were formerly reported as Crevalle.

Fisheries of the Chesapeake Bay States, 1925—Continued

Products	Maryland		Virginia		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Tripletail			25	$4	$25	$4
Tuna			320	17	320	17
White perch	629,485	$59,278	427,275	35,230	1,056,760	94,508
Whiting	80,000	800	33,600	716	113,600	1,516
Yellow perch	231,861	25,379	79,687	7,338	311,548	32,717
Other fish	4,720	70	300	30	5,020	100
Crabs, hard	7,321,116	303,507	18,531,994	523,733	25,853,110	827,240
Crabs, soft	2,325,245	264,276	1,422,250	157,981	3,747,495	422,257
Crawfish	400	40			400	40
Shrimp	550	275			550	275
Squid	38,000	2,440	415,825	23,607	453,825	26,047
Clams, hard, public	109,720	46,450	1,048,544	400,908	1,158,264	447,358
Clams, hard, private			32,008	21,426	32,008	21,426
Oysters, market, public	28,650,678	3,102,960	9,546,327	1,036,500	38,197,005	4,139,460
Oysters, market, private	1,106,042	152,547	11,013,366	1,367,761	12,119,408	1,520,308
Oysters, seed, public	13,300	765	9,855,769	358,555	9,869,069	359,320
Oysters, seed, private			79,450	2,518	79,450	2,518
Scallops			360,732	74,272	360,732	74,272
Terrapin	1,430	1,000	8,400	4,400	9,830	5,400
Turtles	1,033	53	2,700	49	3,733	102
Alewife scales			100,000	10,000	100,000	10,000
Total	56,977,985	4,863,419	276,227,784	9,084,641	333,205,769	13,948,060

Catch of crabs in the Chesapeake Bay States for various years from 1880 to 1925

Years	Maryland					
	Crabs, hard		Crabs, soft		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
1880	1,166,667	$46,850	(1)	(1)		
1887	2,757,638	36,969	1,636,530	$133,788	4,394,168	$170,757
1888	2,674,675	37,438	2,208,829	161,331	4,883,504	198,769
1890	2,388,099	31,723	4,056,110	228,690	6,444,209	260,413
1891	2,776,898	37,460	4,828,872	266,256	7,605,770	303,716
1897	5,333,316	39,949	4,115,879	177,637	9,449,195	217,586
1901	9,824,793	85,884	4,303,582	202,563	14,128,375	288,447
1904	12,665,282	168,996	5,732,865	189,851	18,398,147	358,847
1908	12,786,000	124,000	7,587,000	195,000	20,373,000	319,000
1915	22,491,675	335,375	7,602,207	329,276	30,093,882	664,651
1920	5,165,703	248,160	3,897,271	494,784	9,062,974	742,944
1925	7,321,116	303,507	2,325,245	264,276	9,646,361	567,783

Years	Virginia						Grand total	
	Crabs, hard		Crabs, soft		Total			
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
1880	2,139,200	$32,088	(1)	(1)				
1887	626,820	15,479	(1)	(1)				
1888	956,843	24,669	(1)	(1)				
1890	2,584,794	28,210	440,310	$26,054	3,025,104	$54,264	9,469,313	$314,677
1891	2,208,071	32,683	585,956	29,379	2,794,027	62,062	10,399,797	365,778
1897	5,331,398	28,331	1,068,116	39,914	6,399,514	68,245	15,848,709	285,831
1901	6,113,277	52,863	1,288,424	65,972	7,401,701	118,835	21,530,076	407,282
1904	10,356,052	179,575	1,910,654	92,909	12,266,706	272,484	30,664,853	631,331
1908	23,001,000	239,000	2,082,000	87,000	25,083,000	326,000	45,456,000	645,000
1915	18,765,148	242,754	1,484,238	74,402	20,249,386	317,156	50,343,268	981,807
1920	12,465,342	401,295	1,171,737	164,269	13,637,079	565,564	22,700,053	1,308,508
1925	18,531,994	523,733	1,422,250	157,981	19,954,244	681,714	29,600,605	1,249,497

[1] Statistics not available.

Catch of oysters in the Chesapeake Bay States for various years, 1880 to 1925

Years	Maryland		
	Bushels	*Pounds*	*Value*
1880	10,600,000	74,200,000	$4,730,476
1887	8,148,217	57,037,519	2,683,435
1888	8,531,658	59,721,606	2,877,790
1890	10,450,087	73,150,609	4,854,746
1891	9,945,058	69,615,406	5,295,866
1897	7,254,934	50,784,538	2,885,202
1901	5,685,561	39,798,927	3,031,518
1904	4,429,650	31,007,550	2,417,674
1908	6,232,000	43,624,000	2,228,000
1912	5,510,421	38,572,947	2,127,759
1920	4,547,471	31,832,297	2,291,120
1925	4,252,860	29,770,020	3,256,272

Years	Virginia			Total		
	Bushels	*Pounds*	*Value*	*Bushels*	*Pounds*	*Value*
1880	6,837,320	47,861,240	$2,218,376	17,437,320	122,061,240	$6,948,852
1887	[1] 2,921,140	20,447,980	1,002,901	11,069,357	77,485,499	3,686,336
1888	3,664,433	25,651,031	1,336,012	12,196,091	85,372,637	4,213,802
1890	6,074,025	42,518,175	2,482,348	16,524,112	115,668,784	7,337,094
1891	6,162,086	43,134,602	2,524,348	16,107,144	112,750,008	7,820,214
1897	7,023,848	49,166,936	2,041,683	14,278,782	99,951,474	4,926,885
1901	6,067,669	42,473,683	2,621,915	11,753,230	82,272,610	5,653,433
1904	7,612,289	53,286,023	3,459,676	12,041,939	84,293,573	5,877,350
1908	5,075,000	35,525,000	2,348,000	11,307,000	79,149,000	4,576,000
1912	6,206,098	43,442,686	2,286,340	11,716,519	82,015,633	4,414,099
1920	3,963,569	27,744,983	2,348,961	8,511,040	59,577,280	4,640,081
1925	4,356,416	30,494,912	2,765,334	8,609,276	60,264,932	6,021,606

[1] Exclusive of the James and Potomac Rivers.

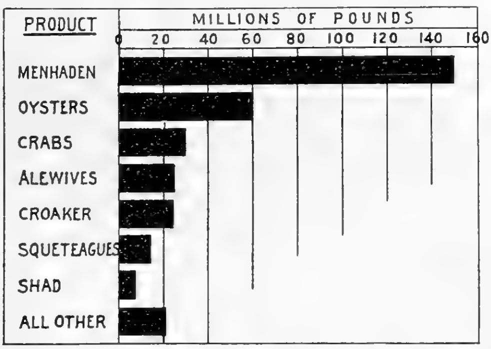

FIGURE 21.—Yield of principal fishery products in the Chesapeake Bay States, 1925

Fisheries of the Chesapeake Bay States for various years, 1880 to 1925

Years	Maryland		Virginia		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
1880	95,712,570	$5,221,715	158,874,609	$3,124,444	254,587,179	$8,346,159
1887	107,981,976	3,514,182	97,635,402	1,606,811	205,617,378	5,120,993
1888	114,788,113	3,813,199	101,318,814	1,836,155	216,106,927	5,649,354
1890	143,905,576	6,019,165	185,282,705	3,636,351	329,188,281	9,655,516
1891	141,177,827	6,460,759	183,993,834	3,647,845	325,171,661	10,108,604
1897	88,588,018	3,617,306	277,993,949	3,179,498	366,581,967	6,796,804
1901	82,975,245	3,767,461	378,183,358	4,613,384	461,158,603	8,380,845
1904	81,128,866	3,336,560	355,315,798	5,584,354	436,444,664	8,920,914
1908	113,796,000	3,306,000	312,515,000	4,716,000	426,311,000	8,022,000
1920	59,530,795	4,198,668	471,219,089	8,541,724	530,749,884	12,740,392
1925	56,977,985	4,863,419	276,227,784	9,084,641	333,205,769	13,948,060

NOTE.—The statistics for 1908 in these tables are from data published by the Bureau of the Census.

SHAD AND ALEWIFE FISHERIES OF THE POTOMAC RIVER

In 1929, these fisheries were prosecuted by 773 fishermen who used 449 motor and other small boats, 424 pound nets, 483 gill nets having a combined area of 472,780 square yards, and 5 haul seines having a combined length of 3,900 yards.

The shad fishery yielded 317,253 fish that weighed 1,052,284 pounds, valued at $141,589, to the fishermen. Compared with the yield for 1928, this is a decrease of 56 per cent in number, 49 per cent in weight, and 34 per cent in value. Of the total number, 78 per cent were taken by Virginia fishermen and the remaining 22 per cent by fishermen from Maryland.

The alewife fishery yielded 7,711,030 fish that weighed 3,084,412 pounds, valued at $54,916, to the fishermen. This is a decrease of 48 per cent in number, 48 per cent in weight, and 6 per cent in value as compared with the yield for 1928. Of the total number, 89 per cent were taken by Virginia fishermen and the remaining 11 per cent by Maryland fishermen.

Shad and alewife fisheries of the Potomac River, 1929

Items	Maryland			Virginia			Total		
	Number	*Pounds*	*Value*	*Number*	*Pounds*	*Value*	*Number*	*Pounds*	*Value*
Fishermen	192			581			773		
Rowboats	67			134			201		
Motor boats	46			202			248		
Pound nets	66			358			424		
Gill nets	63			420			483		
Square yards	290, 577			182, 203			472, 780		
Haul seines	3			2			5		
Yards	900			3, 000			3, 900		
Shad caught:									
With pound nets	5, 346	18, 541	$3, 064	187, 343	611, 927	$93, 981	192, 689	630, 468	$97, 045
With gill nets	48, 137	161, 849	16, 877	60, 197	210, 985	24, 452	108, 334	372, 834	41, 329
With haul seines	15, 130	45, 407	2, 735	1, 100	3, 575	480	16, 230	48, 982	3, 215
Total	68, 613	225, 797	22, 676	248, 640	826, 487	118, 913	317, 253	1, 052, 284	141, 589
Alewives caught:									
With pound nets	809, 000	323, 600	6, 625	6, 641, 530	2, 656, 612	46, 584	7, 450, 530	2, 980, 212	53, 209
With gill nets				75, 500	30, 200	707	75, 500	30, 200	707
With haul seines	75, 000	30, 000	450	110, 000	44, 000	550	185, 000	74, 000	1, 000
Total	884, 000	353, 600	7, 075	6, 827, 030	2, 730, 812	47, 841	7, 711, 030	3, 084, 412	54, 916

Catch of shad in the Potomac River for various years, 1896 to 1929

Year	Maryland			Virginia			Total		
	Number	*Pounds*	*Value*	*Number*	*Pounds*	*Value*	*Number*	*Pounds*	*Value*
1896	233, 238	874, 643	$20, 524	450, 825	1, 690, 594	$43, 084	684, 063	2, 565, 237	$63, 608
1901	146, 000	547, 500	14, 800	648, 462	2, 431, 733	104, 566	794, 462	2, 979, 233	119, 366
1904	83, 147	311, 801	16, 343	289, 500	1, 085, 625	51, 709	372, 647	1, 397, 426	68, 052
1909	31, 158	116, 843	9, 232	172, 813	648, 049	44, 500	203, 971	764, 892	53, 732
1915	17, 196	64, 485	6, 827	165, 206	619, 523	65, 300	182, 402	684, 008	72, 127
1919	94, 512	354, 420	56, 833	449, 957	1, 687, 339	275, 564	544, 469	2, 041, 759	332, 397
1920	80, 944	302, 237	55, 963	448, 414	1, 677, 543	278, 501	529, 358	1, 979, 780	334, 464
1921	49, 681	138, 207	25, 191	356, 191	1, 022, 231	182, 179	405, 872	1, 160, 438	207, 370
1922	203, 682	706, 501	95, 140	680, 494	2, 409, 070	324, 882	884, 176	3, 115, 571	420, 022
1923	93, 619	308, 729	52, 917	257, 927	878, 653	145, 702	351, 546	1, 187, 382	198, 619
1924	37, 505	127, 285	20, 469	134, 805	450, 925	67, 981	172, 310	578, 210	88, 450
1925	46, 008	157, 786	35, 310	158, 574	538, 846	128, 088	204, 582	696, 632	163, 398
1926	51, 601	162, 861	34, 808	285, 061	871, 345	182, 653	336, 662	1, 034, 206	217, 461
1927	30, 720	103, 728	17, 894	191, 601	582, 853	95, 931	222, 321	686, 581	113, 825
1928	138, 496	383, 126	37, 588	577, 924	1, 694, 496	177, 099	716, 420	2, 077, 622	214, 687
1929	68, 613	225, 797	22, 676	248, 640	826, 487	118, 913	317, 253	1, 052, 284	141, 589

NOTE.—The number of shad taken in the Potomac River in 1878 was 186,000; in 1880, 552,872; in 1889 868,900; in 1890, 731,453; and in 1891, 621,977.

Catch of alewives in the Potomac River for various years, 1896 to 1929

Year	Maryland			Virginia			Total		
	Number	*Pounds*	*Value*	*Number*	*Pounds*	*Value*	*Number*	*Pounds*	*Value*
1896 [1]							24,437,885	9,775,154	$39,003
1909	4,883,000	1,953,200	$10,369	24,601,040	9,840,416	$42,854	29,484,040	11,793,616	53,223
1915	335,000	134,000	1,420	7,276,428	2,910,571	30,741	7,611,428	3,044,571	32,161
1919	1,488,583	772,867	15,508	7,379,319	2,904,054	45,508	8,867,902	3,676,921	61,016
1920	1,077,775	538,888	13,940	7,681,561	3,813,780	41,197	8,759,336	4,352,668	55,137
1921	1,395,000	558,000	9,010	8,908,510	3,563,404	35,031	10,303,510	4,121,404	44,041
1922	1,292,500	517,000	3,700	10,074,500	4,029,800	34,642	11,367,000	4,546,800	38,342
1923	2,119,787	847,916	8,764	9,308,782	3,722,912	40,657	11,428,569	4,570,828	49,421
1924	1,834,000	733,600	6,855	13,299,388	5,319,156	49,667	15,133,388	6,052,756	56,552
1925	415,000	166,000	2,070	7,420,380	2,968,152	35,271	7,835,380	3,134,152	37,341
1926	1,295,020	518,600	6,518	12,500,828	5,000,330	48,848	13,795,848	5,518,930	55,366
1927	1,272,000	508,699	5,741	10,336,067	4,136,666	44,847	11,608,067	4,645,365	50,588
1928	1,801,475	720,590	9,565	12,982,180	5,182,472	48,732	14,783,655	5,903,062	58,297
1929	884,000	353,600	7,075	6,827,030	2,730,812	47,841	7,711,030	3,084,412	54,916

[1] Data not enumerated separately for the two States.

TRADE IN FRESH AND FROZEN FISHERY PRODUCTS IN WASHINGTON, D. C.

The municipal fish wharf and market in Washington, D. C., was built about 13 years ago in the southwestern part of the city on an arm of the Potomac River. At the present time 16 firms have stalls in the market, and 6 firms are in private buildings across the street. Altogether they employ about 71 persons. These firms conduct a wholesale and retail business; chiefly wholesale, however. Some of the fish from the boats and vessels are sold at auction direct to the wholesalers. Several wholesalers also sell fish by auction to the hucksters. The greater part of the business in the market is transacted at a set price.

Although the market is so situated that fishing boats may land their fish directly, only about 10 per cent of the fish are received in this way. The greater part arrive by truck from points in Maryland and Virginia, especially from the vicinity of Solomons and Galesville. Fish arriving by rail from points along the Atlantic coast, Great Lakes, or the Pacific coast are also transported by truck from the rail heads, as the market has no direct rail connections.

During 1929 the receipts of fresh and frozen fishery products amounted to 9,208,465 pounds, or an increase of 12 per cent compared with the previous year, and 19 per cent compared with the 5-year average.

There has been very little change in the kinds of fish handled at the market in the past nine years. Taking those species that constituted 75 per cent of the trade for the various years from 1921 to 1929, squeteagues, or "sea trout," made up the greater portion of the trade each year. Croaker has usually been second, river herring third, oysters fourth or fifth, shad fourth or fifth, haddock sixth, and butterfish seventh or eighth. Striped bass has generally been seventh in importance, but during 1929 dropped to ninth in importance.

The trade at the municipal fish market is most active during the months from March to October, inclusive—the largest quantities being handled during the months of April and May. The unusual activity during these latter months can be accounted for chiefly by the large amounts of river herring, croaker, and shad, which are handled mainly during these two months.

The retail business in Washington, D. C., is carried on by the stores in the municipal market, stores in markets uptown, grocery stores, meat markets, and hucksters with horse and wagon. There are about 35 of these fish peddlers doing business at the present time, although their numbers are said to become less each year due to the fact that many grocery stores in the city are now marketing fish.

Not all of the fish consumed in the District of Columbia goes through the municipal fish wharf and market. It has been estimated that about 3,000,000 pounds are received direct from outside sources by hotels, fish markets, and restaurants. This, added to the amount received at the municipal fish wharf, would make a total of about 12,200,000 pounds of fresh and frozen fishery products handled in the District of Columbia during 1929. Virtually the entire amount was consumed in the district. It is estimated that the population of the District of Columbia was 565,000 on July 1, 1929, making the per capita consumption of fresh and frozen fishery products during 1929 about 22 pounds in the round weight. During 1928 the per capita consumption was figured at 19 pounds in the round weight.

Fishery products received at municipal fish wharf and market, Washington, D. C., 1929, in pounds

Species	January	February	March	April	May	June	July
Bass, black or sea	300		500	600	2,800	2,100	1,800
Bluefish			200		4,100	9,600	26,100
Butterfish	3,100	2,100	600	4,300	51,700	125,900	78,100
Carp	12,700	6,300	16,800	26,100	12,500	12,200	4,400
Catfish	10,600	9,100	46,100	21,800	10,800	16,500	7,200
Cod	1,000	2,300	1,800	1,800	700	1,000	2,000
Crappie	100						
Croaker	28,000	30,300	192,000	284,100	201,500	173,600	243,000
Cusk			200				
Eels	225		2,100	1,200	900	100	300
Flounders	22,200	33,500	13,900	20,400	27,900	11,200	7,800
Haddock	44,700	42,420	46,660	39,530	42,130	39,540	40,850
Hake	7,000	400	100				
Halibut	7,200	4,300	6,700	7,600	5,800	3,900	5,800
Herring, river	18,700	48,800	129,600	364,200	185,400	4,800	
Hickory shad or "jacks"	3,650	1,100	1,500	4,000	200		
Kingfish	400	200	400	6,600	400		
Mackerel	34,000	14,400	3,400	13,600	19,800	39,800	37,400
Mullet	3,400	1,100	400	200			
Perch	15,300	18,700	58,700	20,800	6,800	6,800	2,400
Pigfish					400		
Pike or pickerel	2,400	100	900				
Pollock	11,700	3,600			1,200	800	1,700
Pompano				400			100
Redfish or red drum	150				510	90	
Red snapper	600	200		800			
Salmon	3,500	3,100	1,200	200		600	2,800
Scup or porgy		300			1,000	5,000	7,100
Shad	15,150	30,200	146,600	260,400	236,300	13,300	
Sheepshead	200	800	200			300	
Smelt	4,880	2,400	700				
Spot	2,000	5,200	400	1,200	8,700	21,300	25,200
Squeteagues or "sea trout"	22,700	33,000	16,300	61,100	218,700	243,500	266,000
Squid					400		200
Striped bass	9,500	15,100	41,500	51,700	16,200	10,300	29,200
Sturgeon				1,450	650	50	
Sunfish		200					
Swordfish						200	1,300
Tilefish	200	1,200	800	1,300	700	200	
Whiting	5,400	1,700		200			
Clams, hard (meat)	3,776	2,944	5,568	4,192	6,880	6,944	6,400
Oysters:							
In the shell (meat)	30,429	17,962	11,074	7,021	196		
Opened (meat)	74,201	51,835	27,184	1,155			
Scallops	160	160	80	240	560	160	80
Crabs			750	6,870	30,900	92,790	128,610
Crabmeat	1,630	1,390	1,965	7,300	13,145	26,035	32,000
Crawfish or spiny lobster			50				
Lobster	150	250	550	1,700	450	350	50
Shrimp	3,000	600	3,100	3,400	5,200	13,400	7,100
Turtles	108	274	50	384	166	386	182
Frogs				225	95	29	
Total	404,409	387,535	780,631	1,228,067	1,115,782	882,774	965,772

Fishery products received at municipal fish wharf and market, Washington, D. C., 1929, in pounds—Continued

Species	August	September	October	November	December	Total
Bass, black or sea	2,000	200		1,000	800	12,100
Bluefish	37,200	33,800	29,300	9,400	200	149,900
Butterfish	52,000	41,000	13,400	24,300	8,800	405,300
Carp	4,600	6,600	8,600	12,800	19,400	143,000
Catfish	4,200	10,800	26,200	22,700	10,400	196,400
Cod	700	1,000	1,100	3,600	600	17,600
Crappie						100
Croaker	161,400	87,600	61,800	55,600	62,800	1,581,700
Cusk						200
Eels	100	600	4,100	2,100	800	12,525
Flounders	10,000	8,400	21,400	21,800	16,400	214,900
Gizzard shad			1,600	3,700	4,200	9,500
Haddock	35,770	40,120	53,060	42,050	32,310	499,140
Hake	100		10,800	83,800	16,000	118,200
Halibut	4,400	3,800	9,400	4,400	7,000	70,300
Herring, river		600				752,100
Hickory shad or "jacks"						10,450
Kingfish	200	400	800	6,300	4,300	20,000
Mackerel	19,200	17,000	26,000	11,800	14,000	250,400
Mullet		5,200	800	2,600	1,400	15,100
Perch	3,000	2,800	7,600	11,900	22,200	177,000
Pigfish		1,200				1,600
Pike or pickerel		400	3,400	1,800	2,200	11,200
Pollock	2,800	3,000	1,500	5,400	2,700	34,400
Pompano						500
Redfish or red drum	600	420	30	30	1,200	3,030
Red snapper	200			800	1,800	4,400
Salmon	1,600	2,200	7,700	1,900	3,800	28,600
Scup or porgy	200	600		1,600		15,800
Shad						701,950
Shark	36					36
Sheepshead						1,500
Smelt				150	815	8,945
Spot	23,200	21,600	49,700	11,200	2,100	171,800
Squeteagues or "sea trout"	310,400	353,000	271,300	143,200	72,400	2,011,600
Squid	200			1,400		2,200
Striped bass	15,300	14,300	81,600	25,700	11,700	322,100
Sturgeon		72	150			2,372
Sunfish						200
Swordfish	950	500	600	300		3,850
Tilefish		100	700	1,200	1,000	7,400
Whitefish		200				200
Whiting			3,000	2,000	15,000	27,300
Clams, hard (meat)	6,816	5,344	5,408	3,936	2,976	[1] 61,184
Oysters:						
In the shell (meat)		7,532	25,774	28,133	31,087	[2] 159,208
Opened (meat)		12,458	72,955	78,218	69,919	[3] 387,925
Scallops		240	640	800	1,760	4,880
Crabs	84,750	31,155	4,950			380,775
Crabmeat	21,610	9,430	6,625	2,725	1,950	126,405
Crawfish or spiny lobster	100			50		200
Crawfish or spiny lobster meat	10					10
Lobster	100	250	200	250		4,300
Lobster meat	100					100
Shrimp	9,000	8,600	7,100	2,800	1,000	64,300
Turtles	8	168	5	24	176	1,931
Frogs						349
Total	812,850	732,689	819,297	633,466	445,193	9,208,465

[1] 7,648 bushels. [2] 22,744 bushels. [3] 47,021 gallons.

NOTE.—The clams have been reduced to pounds on the basis of 8 pounds of meat to a bushel, the oysters on the basis of 7 pounds of meat to a bushel and 8¼ pounds to a gallon.

Fishery products received at municipal fish wharf and market, Washington, D. C., 1921 to 1929

Year	Pounds	Year	Pounds
1921	9,066,744	1926	7,511,427
1922	6,442,663	1927	7,997,673
1923	5,678,157	1928	8,198,957
1924	8,007,704	1929	9,208,465
1925	7,041,058		

FISHERIES OF THE SOUTH ATLANTIC STATES

During 1928 the catch of fishery products of the South Atlantic States (North Carolina, South Carolina, Georgia, and the east coast of Florida) exceeded that in any year for which there are records, except that in 1927. These fisheries gave employment to 11,882 fishermen or 3 per cent more than in 1927. Of the total number of fishermen employed during 1928, 1,306 regular fishermen were engaged on vessels, and 6,449 regular and 4,127 casual fishermen were employed in the shore and boat fisheries. Their catch amounted to 258,440,435 pounds, valued at $6,027,154. This is a decrease of 1 per cent in the catch and an increase of 6 per cent in the value of the catch as compared with the quantity and its value for 1927. Of the total catch in 1928, 210,131,838 pounds, valued at $3,757,326, were fish, and 48,308,597 pounds, valued at $2,269,828, were shellfish and miscellaneous products.

Based on the value to the fishermen, shrimp, with a production of 33,310,020 pounds, valued at $1,457,941, was the most important product. Shad was second with a production of 4,446,851 pounds,

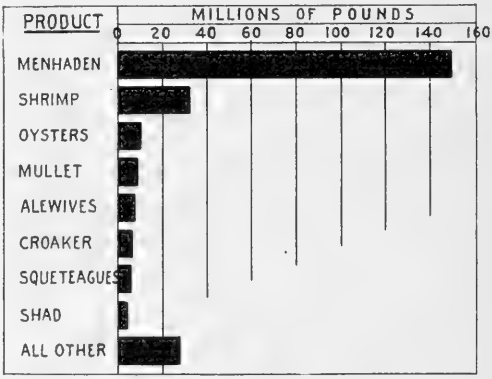

FIGURE 22.—Yield of principal fishery products in the South Atlantic States, 1928

valued at $817,433. Other products of importance were menhaden, 150,843,955 pounds, valued at $584,638; oysters, 10,588,774 pounds of meats, valued at $426,958; squeteagues or "sea trout," 6,403,589 pounds, valued at $420,155; and mullet, 9,376,652 pounds, valued at $420,021. Other products were valued individually at less than $200,000.

The industries related to the fisheries of the South Atlantic States gave employment to 3,496 persons, of whom 233 were engaged in transporting fishery products, 1,653 were in the wholesale trade and received $704,687 in salaries and wages, and 1,610 were in the prepared-products and by-products trade and received $658,185 in salaries and wages. There were 228 establishments in the wholesale fish trade handling primary products and 60 establishments were in the prepared-products and by-products trade. The latter manufactured products, valued at $4,112,733, consisting principally of canned oysters, shrimp, and menhaden products. In addition, individual fishermen in the South Atlantic States prepared fishery products valued at $80,860, consisting principally of salted fish.

Fisheries of the South Atlantic States, 1928

SUMMARY OF CATCH

Products	North Carolina		South Carolina		Georgia	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Fish	134, 795, 134	$2, 125, 118	1, 159, 120	$125, 208	30, 892, 594	$236, 631
Shellfish, etc	7, 104, 028	504, 096	6, 273, 294	191, 606	11, 176, 186	629, 656
Total	141, 899, 162	2, 629, 214	7, 432, 414	316, 814	42, 068, 780	866, 287

Products	Florida (east coast)		Total	
	Pounds	*Value*	*Pounds*	*Value*
Fish	43, 284, 990	$1, 270, 369	210, 131, 838	$3, 757, 326
Shellfish, etc	23, 755, 089	944, 470	48, 308, 597	2, 269, 828
Total	67, 040, 079	2, 214, 839	258, 440, 435	6, 027, 154

OPERATING UNITS: BY STATES

Items	North Carolina	South Carolina	Georgia	Florida (east coast)	Total
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	944	26	146	190	1, 306
On boats and shore—					
Regular	2, 656	552	686	2, 555	6, 449
Casual	2, 463	927	456	281	4, 127
Total	6, 063	1, 505	1, 288	3, 026	11, 882
Vessels:					
Motor	75	4	26	25	130
Net tonnage	1, 648	53	351	469	2, 521
Sail	63				63
Net tonnage	568				568
Total vessels	138	4	26	25	193
Total net tonnage	2, 216	53	351	469	3, 089
Boats:					
Motor	1, 284	43	229	1, 202	2, 758
Other	1, 893	961	508	1, 131	4, 493
Accessory boats	131	8	55	14	208
Apparatus:					
Purse seines—					
Menhaden	37		3	4	44
Yards	12, 520		900	1, 200	14, 620
Other	3			3	6
Yards	600			900	1, 500
Haul seines—					
Common	591	39	13	78	721
Yards	94, 930	4, 325	1, 405	54, 130	154, 790
Long	29				29
Yards	32, 500				32, 500
Gill nets—					
Drift	224	118	191	944	1, 477
Square yards	188, 435	96, 367	139, 495	1, 507, 500	1, 931, 797
Set	12, 517	371	179	6	13, 073
Square yards	2, 138, 944	118, 530	8, 608	7, 200	2, 273, 282
Runaround	661	16	9		686
Square yards	289, 051	4, 765	3, 565		297, 381
Trammel nets				3	3
Square yards				1, 350	1, 350
Lines—					
Troll				753	753
Hooks				1, 427	1, 427
Hand	191	84	8	539	822
Hooks	357	417	16	569	1, 359
Trot with hooks	24			356	380
Hooks	600			58, 600	59, 200
Trot with baits or snoods	147	4	77	2	230
Baits or snoods	132, 300	300	5, 404	1, 000	139, 004
Pound nets	2, 406			21	2, 427
Weirs	16				16
Wheels	5				5
Fyke nets	723		50	22	795
Dip nets—					
Common	287			46	333
Drop			6		6

Fisheries of the South Atlantic States, 1928—Continued

OPERATING UNITS: BY STATES—Continued

Items	North Carolina	South Carolina	Georgia	Florida (east coast)	Total
Apparatus—Continued.	*Number*	*Number*	*Number*	*Number*	*Number*
Cast nets		3	18	19	40
Bow nets	19				19
Drag nets	81				81
Push nets	11				11
Otter trawls—					
Fish	1				1
Yards at mouth	40				40
Shrimp	42	9	238	353	642
Yards at mouth	715	453	13,175	6,673	21,016
Box traps	50				50
Turtle traps	4				4
Pots, eel	1,544			65	1,609
Sea crawfish				1,998	1,998
Spears	83	34		10	127
Dredges—					
Oyster	200	4			204
Yards at mouth	626	16			642
Scallop	773				773
Yards at mouth	742				742
Tongs	492	301	179	94	1,066
Rakes	1,437	60			1,497
Forks				62	62
Grabs		397	258		655
Hooks, stone crab				44	44

CATCH: BY STATES

Species	North Carolina		South Carolina		Georgia	
FISH	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	7,808,031	$110,727	2,000	$100		
Black bass	90,436	13,333				
Bluefish	753,979	45,830	3,500	280	50,000	$5,000
Bonito	7,950	160				
Bowfin	20,119	396				
Butterfish	111,966	2,576				
Cabio or crab eater	250	5				
Carp	754,820	40,477	1,800	54		
Catfish and bullheads	483,233	16,072	2,400	87	140,860	14,055
Cero	1,500	120				
Cod	296	10				
Crappie	4,404	429				
Crevalle	780	30				
Croaker	6,775,264	101,362	12,100	630	10,300	1,030
Drum, black	8,687	220	3,550	106	3,250	170
Drum, red, or redfish	237,435	5,942	4,870	391	6,000	375
Eels	76,733	5,753				
Flounders	455,214	25,550	20,700	2,040	15,690	1,263
Garfish	1,000	5				
Gizzard shad	109,635	1,539				
Groupers					8,274	414
Grunts	1,850	143	5,625	450		
Hake	380	19				
Harvestfish or "starfish"	781,794	19,537				
Hickory shad	397,184	19,269	14,348	1,976	53,552	6,045
Jewfish					3,200	160
King whiting or "kingfish"	780,236	34,053	61,500	5,290	56,000	2,450
Menhaden	99,302,355	430,998			30,030,000	113,310
Mullet	2,501,553	143,683	290,980	17,475	57,325	4,175
Muttonfish					1,650	132
Pigfish	249,768	4,835				
Pike	18,593	1,753				
Pinfish or sailor's choice	100	1				
Pollock	150	5				
Pompano	8,395	926				
Porgies	125	10				
Seabass	423,867	27,874	271,000	21,650	85,200	8,380
Shad	3,118,415	573,007	320,237	66,314	317,267	73,676
Sharks			6,300	500		
Sheepshead, salt water	22,182	1,164			1,470	200
Snapper, red	2,350	174			22,500	1,920
Spadefish	13,756	333				
Spanish mackerel	175,880	15,079				
Spot	2,954,349	66,182	89,830	2,825	7,900	640
Squeteagues or "sea trout"	5,127,459	297,308	19,520	1,400	18,116	2,567
Squirrelfish			5,500	440		

Fisheries of the South Atlantic States, 1928—Continued

CATCH: BY STATES—Continued

Species	North Carolina		South Carolina		Georgia	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
FISH—continued						
Striped bass	507,406	$71,935			740	$107
Sturgeon	8,435	1,279	23,360	$3,200	1,750	350
Suckers	15,639	847				
Sunfish	22,227	525				
Tripletail	143	6			1,550	212
Tuna	71	4				
White perch	458,356	30,367				
Whiting	438	12				
Yellow perch	175,080	12,095				
Yellowtail	24,866	1,159				
Total	134,795,134	2,125,118	1,159,120	125,208	30,892,594	236,631
SHELLFISH, ETC.						
Crabs, hard	846,917	16,821	2,370	500	569,341	19,416
Crabs, soft	628,944	96,365				
Shrimp	845,349	30,447	431,441	17,526	9,526,044	545,354
Clams, hard	324,232	61,168	26,184	4,005	800	125
Oysters, market, public	2,895,207	166,690	5,077,310	143,827	199,640	12,976
Oysters, market, private	4,480	800	720,405	19,040	848,785	41,694
Oysters, seed, public	163,800	5,850				
Scallops, bay	1,394,124	125,845				
Octopus	600	76	2,000	400		
Terrapin	28	7	13,584	6,308	31,576	10,091
Turtles	347	27				
Total	7,104,028	504,096	6,273,294	191,606	11,176,186	629,656
Grand total	141,899,162	2,629,214	7,432,414	316,814	42,068,780	866,287

Species	Florida (east coast)		Total	
	Pounds	*Value*	*Pounds*	*Value*
FISH				
Alewives	370,128	$2,935	8,180,159	$113,762
Amberjack	11,847	530	11,847	530
Barracuda	12,000	360	12,000	360
Black bass	140,616	16,241	231,052	29,574
Bluefish	599,020	68,454	1,406,499	119,564
Blue runner or hardtail	123,324	4,177	123,324	4,177
Bonito	2,000	300	9,950	460
Bowfin			20,119	396
Butterfish	1,440	43	113,406	2,619
Cabio or crab eater	200	10	450	15
Carp			756,620	40,531
Catfish and bullheads	3,203,091	130,601	3,829,584	160,815
Cero	5,000	250	6,500	370
Cod			296	10
Crappie	387,457	27,212	391,861	27,641
Crevalle	213,736	6,483	214,516	6,513
Croaker	43,839	1,458	6,841,503	104,480
Dolphin	6,000	600	6,000	600
Drum, black	125,450	3,556	140,937	4,052
Drum, red, or redfish	202,024	9,626	450,329	16,334
Eels	16,013	646	92,746	6,399
Flounders	46,557	1,573	538,161	30,426
Garfish			1,000	5
Gizzard shad			109,635	1,539
Groupers	146,966	6,402	155,240	6,816
Grunts	38,643	1,531	46,118	2,124
Hake			380	19
Harvestfish or "starfish"			781,794	19,537
Hickory shad	35,480	1,419	500,564	28,709
Hogfish	3,000	90	3,000	90
Jewfish	13,900	401	17,100	561
Kingfish or "king mackerel"	2,645,656	136,717	2,645,656	136,717
King whiting or "kingfish"	376,490	14,142	1,274,226	55,935
Ladyfish	3,000	60	3,000	60
Menhaden	21,511,600	40,330	150,843,955	584,638
Mojarro	477,072	21,471	477,072	21,471
Moonfish	192	5	192	5
Mullet	6,526,794	254,688	9,376,652	420,021
Muttonfish	114,900	10,182	116,550	10,314
Permit	3,895	120	3,895	120
Pigfish	124,078	3,922	373,846	8,757
Pike	2,000	100	20,593	1,853

Fisheries of the South Atlantic States, 1928—Continued

CATCH: BY STATES—Continued

Species	Florida (east coast)		Total	
FISH—continued	*Pounds*	*Value*	*Pounds*	*Value*
Pinfish or sailors choice	179,301	5,024	179,401	5,025
Pollock			150	5
Pompano	283,889	78,374	292,284	79,300
Porgies	22,000	760	22,125	770
Seabass	38,169	4,213	818,236	62,117
Shad	690,932	104,436	4,446,851	817,433
Sharks			6,300	500
Sheepshead, salt-water	75,744	3,514	99,396	4,878
Snapper, mangrove	89,505	4,870	89,505	4,870
Snapper, red	47,050	4,629	71,900	6,723
Snook or sergeantfish	250,994	12,265	250,994	12,265
Spadefish	11,904	381	25,660	714
Spanish mackerel	2,071,382	135,909	2,250,262	150,988
Spot	228,153	7,145	3,280,232	76,792
Squeteagues or "sea trout"	1,238,494	118,880	6,403,589	420,155
Squirrelfish			5,500	440
Striped bass			508,146	72,042
Sturgeon			33,545	4,829
Suckers			15,639	847
Sunfish	456,231	18,144	478,458	18,669
Tripletail	400	16	2,093	234
Tuna			71	4
White perch			458,356	30,367
Whiting			438	12
Yellow perch			175,080	12,095
Yellowtail	64,434	5,174	89,300	6,333
Total	43,284,990	1,270,369	210,131,838	3,757,326
SHELLFISH, ETC.				
Crabs, hard	134,276	7,334	1,552,904	44,071
Crabs, soft			628,944	96,365
Crabs, stone	35,000	3,850	35,000	3,850
Sea crawfish or spiny lobster	367,106	29,368	367,106	29,368
Shrimp	22,507,186	864,614	33,310,020	1,457,941
Clams, hard	25,840	$3,092	377,056	$68,390
Oysters, market, public	577,787	30,141	8,749,944	353,634
Oysters, market, private	101,360	5,940	1,675,030	67,474
Oysters, seed, public			163,800	5,850
Scallops, bay			1,394,124	125,845
Octopus			2,600	476
Terrapin			45,188	16,406
Turtles	6,534	131	6,881	158
Total	23,755,089	944,470	48,308,597	2,269,828
Grand total	67,040,079	2,214,839	258,440,435	6,027,154

CATCH OF CERTAIN SHELLFISH SHOWN IN NUMBERS AND BUSHELS

Products	North Carolina		South Carolina		Georgia	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Crabs, hard ... number	2,540,751	$16,821	7,110	$500	1,708,023	$19,416
Crabs, soft ... do	1,886,832	96,365				
Clams, hard ... bushels	40,529	61,168	3,273	4,005	100	125
Oysters, market, public ... do	413,601	166,690	725,330	143,827	28,520	12,976
Oysters, market, private ... do	640	800	102,915	19,040	121,255	41,694
Oysters, seed, public ... do	23,400	5,850				
Scallops ... do	232,354	125,845				

Products	Florida (east coast)		Total	
	Quantity	*Value*	*Quantity*	*Value*
Crabs, hard ... number	402,828	$7,334	4,658,712	$44,071
Crabs, soft ... do			1,886,832	96,365
Crabs, stone ... do	46,667	3,850	46,667	3,850
Clams, hard ... bushels	3,230	3,092	47,132	68,390
Oysters, market, public ... do	82,541	30,141	1,249,992	353,634
Oysters, market, private ... do	14,480	5,940	239,290	67,474
Oysters, seed, public ... do			23,400	5,850
Scallops ... do			232,354	125,845

Industries related to the fisheries of the South Atlantic States, 1928

Items	North Carolina	South Carolina	Georgia	Florida (east coast)	Total
Transporting:					
Persons engaged	45	143	44	1	233
Vessels—					
Motor	28	22	18	1	69
Net tonnage	295	246	223	16	780
Sail		40	3		43
Net tonnage		389	23		412
Total vessels	28	62	21	1	112
Total net tonnage	295	635	246	16	1,192
Wholesale trade:					
Establishments	85	18	24	101	228
Persons engaged	440	236	395	582	1,653
Salaries and wages	$138,799	$56,468	$148,858	$360,562	$704,687
Prepared products and by-products industries:					
Establishments	21	18	13	8	60
Persons engaged	260	656	497	197	1,610
Salaries and wages	$141,580	$159,720	$172,338	$184,547	$658,185
Products	$1,160,482	$1,028,113	$886,049	$1,038,089	$4,112,733
Products prepared by the fishermen	$69,993	$10,867			$80,860

NORTH CAROLINA

In 1928 North Carolina ranked first among the States in the South Atlantic section in the importance of its fisheries, employing 51 per cent of the total number of fishermen and accounting for 55 per cent of the total catch. The fisheries and industries related to the fisheries employed 6,808 persons, which is 1 per cent less than the number employed in 1927. Of the total, 6,663 were fishermen, 45 were employed on transporting vessels, 440 in the wholesale trade, and 260 in the prepared products and by-products industries.

The total catch amounted to 141,899,162 pounds, valued at $2,629,214. This is a decrease of 2 per cent in the catch and 5 per cent in the value of the catch as compared with the catch and its value for 1927. Of the total value of the catch, that for shad accounted for 22 per cent; menhaden, 16 per cent; squeteagues or "sea trout," 11 per cent; and oysters, 7 per cent. Of the total production, that of menhaden accounted for 70 per cent; alewives, 6 per cent; croakers, 5 per cent; and squeteagues or "sea trout," 4 per cent.

OPERATING UNITS BY GEAR

The catch of fishery products in North Carolina during 1928 was taken by 6,063 fishermen, who used 75 motor vessels, 63 sailing vessels, 3,177 motor and other small boats, and 20 major types of gear. The vessels had a combined capacity of 2,216 net tons. The fisheries accounting for the greatest number of persons were the haul-seine fishery employing 2,049 fishermen and the rake fishery employing 1,437 fishermen.

CATCH BY GEAR

Three types of gear accounted for 88 per cent of the fish taken in the fisheries of North Carolina during 1928. Listed in order of their importance, they were purse seines, which accounted for 69 per cent of the catch; haul seines, 10 per cent; and pound nets, 9 per cent. The catch by purse seines consisted almost exclusively of menhaden; that by haul seines principally croakers, squeteagues or "sea trout," spot, alewives, and mullet; and that by pound nets chiefly alewives, squeteagues or "sea trout," shad, and croakers.

OPERATING UNITS BY COUNTIES

Carteret County was foremost in the number of persons fishing, accounting for 38 per cent of the total number. Dare County followed with 10 per cent. Other counties employing a considerable number of fishermen listed in order of their importance in this respect were Brunswick, New Hanover, Beaufort, and Currituck. Carteret County also ranked first in the number of vessels and motor and other small fishing boats operated accounting for 57 per cent of the total number of fishing vessels and 35 per cent of the motor and other small fishing boats. Beaufort County accounted for 17 per cent of the total number of vessels, and Dare County accounted for 12 per cent of the motor and other small fishing boats.

CATCH BY COUNTIES

Fishing was prosecuted along the coast and in the coastal rivers and bays of 25 counties of North Carolina during 1928. Ranked according to value the fisheries of Carteret County were most important, accounting for 58 per cent of the total catch and 35 per cent of the total value of the catch. Dare County was next in the value of the catch, accounting for 5 per cent of the quantity and 23 per cent of the value. Other counties listed in order of their importance with respect to value of the catch were Brunswick, Pamlico, Beaufort, and Chowan.

Fisheries of North Carolina, 1928

OPERATING UNITS: BY GEAR

Items	Purse seines		Haul seines		Gill nets			
	Menhaden	Other	Common	Long	Drift	Stake	Runaround	Set
Fishermen:	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*
On vessels	603		13	109		4	2	
On boats and shore—								
Regular	7	21	1,310	61	168	185	375	415
Casual	9		726		167	108	127	131
Total	619	21	2,049	170	335	297	504	546
Vessels:								
Motor—								
5 to 10 tons	5		3	22		1	1	
11 to 20 tons	2			3				
21 to 30 tons	4							
31 to 40 tons	6							
41 to 50 tons	7							
51 to 60 tons	5							
61 to 70 tons	3							
71 to 80 tons	2							
Total	34		3	25		1	1	
Net tonnage	1,348		22	182		6	6	
Sail—								
11 to 20 tons				1				
Total				1				
Net tonnage				11				
Total vessels	34		3	26		1	1	
Total net tonnage	1,348		22	193		6	6	
Boats:								
Motor	3	3	223	25	32	134	120	221
Other	4	6	345	19	161	98	280	179
Apparatus:								
Number	37	3	591	29	224	8,851	661	3,666
Length, yards	12,520	600	94,930	32,500				
Square yards					188,435	646,188	289,051	1,492,756

Fisheries of North Carolina, 1928—Continued

OPERATING UNITS: BY GEAR—Continued

Items	Lines: Hand	Lines: Trot with hooks	Lines: Trot with baits or snoods	Pound nets	Weirs	Wheels	Fyke nets	Dip nets	Bow nets	Drag nets	Push nets
Fishermen:	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*
On vessels	13							2			
On boats and shore—											
Regular	71		70	449			35	77		26	11
Casual	37	24	100	207	4	5	42	208	19	55	
Total	121	24	170	656	4	5	77	287	19	81	11
Vessels:											
Motor—											
5 to 10 tons	3							1			
Total	3							1			
Net tonnage	25							7			
Total vessels	3							1			
Total net tonnage	25							7			
Boats:											
Motor	29		91	281			24				
Other	15	15	58	169	4	5	51	199	19	36	
Apparatus:											
Number	191	24	147	2,406	16	5	723	287	19	81	11
Hooks, baits or snoods	357	600	132,300								

Items	Other trawls: Fish	Other trawls: Shrimp	Box traps	Turtle traps	Eel pots	Spears	Dredges: Oyster	Dredges: Scallop	Tongs	Rakes	By hand	Total, exclusive of duplication
Fishermen:	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*
On vessels	4	9					184	2	16			944
On boats and shore—												
Regular		77			30	54	81	193	190	659	73	2,656
Casual		2	15	1	15	29	14	106	252	778	42	2,463
Total	4	88	15	1	45	83	279	301	458	1,437	115	6,063
Vessels:												
Motor—												
5 to 10 tons	1	3					1	1	6			43
11 to 20 tons									1			5
21 to 30 tons												4
31 to 40 tons												6
41 to 50 tons												7
51 to 60 tons												5
61 to 70 tons												3
71 to 80 tons												2
Total	1	3					1	1	7			75
Net tonnage	10	23					7	8	55			1,648
Sail—												
5 to 10 tons							48					48
11 to 20 tons							13					14
21 to 30 tons							1					1
Total							62					63
Net tonnage							557					568
Total vessels	1	3					63	1	7			138
Total net tonnage	10	23					564	8	55			2,216
Boats:												
Motor		39	3		27		13	250	108	22	5	1,284
Other				1	13	72	32	19	289	559	78	1,893
Apparatus:												
Number	1	42	50	4	1,544	83	200	773	492	1,437		
Yards at mouth	40	715					626	742				

Fisheries of North Carolina, 1928—Continued

CATCH: BY GEAR

Species	Purse seines				Haul seines			
	Menhaden		Other		Common		Long	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives					1,871,676	$26,200		
Black bass					85,482	12,519		
Bluefish	600	$60			114,665	6,425	123,040	$5,274
Bonito					2,950	85		
Bowfin					11,280	148		
Butterfish					5,040	146	675	27
Carp					527,645	27,858	3,500	70
Catfish and bullheads					195,558	5,063	3,500	70
Cod					50	2		
Crappie					1,434	74		
Crevalle					480	24		
Croaker					1,520,103	22,549	2,400,975	35,142
Drum, black					3,722	113	100	2
Drum, red, or redfish					77,574	2,181	79,900	1,548
Eels					1,268	27		
Flounders					31,236	1,612	10,005	445
Garfish					600	3		
Gizzard shad					20,220	261		
Harvestfish or "starfish"					18,060	585	2,475	99
Hickory shad					48,822	2,442	2,000	110
King whiting or "kingfish"					159,600	6,378	14,710	640
Menhaden	98,583,200	428,124			605,455	2,448	113,700	426
Mullet	22,835	1,142			1,417,169	81,120	2,200	110
Pigfish					113,673	2,459	100,850	1,554
Pike					9,070	861		
Pollock					150	5		
Pompano					3,334	434	2,380	231
Shad					140,207	20,714	1,080	231
Sheepshead, salt-water					8,970	327	4,750	341
Spadefish					400	12	650	26
Spanish mackerel					6,361	826	1,715	168
Spot					1,120,277	30,809	754,300	13,050
Squeteagues or "sea trout"					1,270,350	92,071	673,250	39,415
Striped bass			4,985	$614	218,452	28,068	3,095	276
Sturgeon					3,452	655	160	15
Suckers					775	43		
Sunfish					13,880	179		
White perch					232,588	12,091	300	20
Yellow perch					60,320	3,227		
Yellowtail					20,851	987	1,000	20
Crabs, soft					411,180	61,978		
Shrimp					159,215	4,675		
Total	98,606,635	429,326	4,985	614	10,493,594	458,684	4,300,310	99,310

Species	Gill nets							
	Drift		Stake		Runaround		Set	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	36,000	$840	133,330	$1,820	92,700	$1,840	179,325	$2,799
Black bass							84	14
Bluefish	188,145	9,410	82,990	6,450	82,638	5,337	51,869	4,095
Bonito							5,000	75
Bowfin			200	5			304	3
Butterfish							2,500	51
Carp			9,350	105	1,900	30	4,596	201
Catfish and bullheads			3,400	87	3,225	89	18,657	685
Crappie			170	34	660	38		
Croaker	500	20	258,440	4,628	341,834	5,735	1,142,371	14,103
Drum, black					390	15	488	7
Drum, red, or redfish			5,650	149	38,874	972	5,637	178
Flounders			6,240	302	8,160	584	4,047	291
Garfish			200	1	200	1		
Gizzard shad							4,954	98
Hickory shad	15,100	1,206	84,315	3,655	1,025	55	79,571	4,503
King whiting or "kingfish"			400	10	17,150	990	528,020	23,079
Mullet	52,723	3,420	50,834	3,464	934,787	52,824	19,364	1,517
Pigfish	3,000	181	4,060	90	17,740	323	1,800	45
Pike			20	2	80	5	423	37
Pompano			10	1	41	3		
Sea bass					1,500	120		
Shad	90,247	19,914	489,743	91,208			729,842	130,320

Fisheries of North Carolina, 1928—Continued

CATCH: BY GEAR—Continued

Species	Gill nets							
	Drift		Stake		Runaround		Set	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Sheepshead, salt-water					1, 182	$73	100	$6
Spadefish							102	2
Spanish mackerel	94, 000	$7, 520	3, 321	$262	18, 343	1, 703	9, 930	1, 243
Spot	58, 900	1, 795	88, 884	1, 555	334, 057	8, 741	422, 268	7, 022
Squeteagues or "sea trout"	17, 480	1, 001	193, 846	12, 828	394, 628	24, 798	557, 931	28, 130
Striped bass	2, 000	300	31, 524	4, 295	3, 765	489	80, 538	12, 616
Sturgeon	3, 385	350	519	79			281	51
Suckers					300	4	1, 744	64
Sunfish			30	6			272	7
Tuna							71	4
White perch			17, 240	901	2, 050	209	25, 235	1, 732
Yellow perch			234	19	1, 135	81	2, 005	90
Yellowtail			173	4	235	16	30	1
Total	561, 480	45, 957	1, 465, 123	131, 960	2, 298, 599	105, 075	3, 879, 359	233, 069

Species	Lines						Pound nets	
	Hand		Trot with hooks		Trot with baits or snoods			
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives							5, 369, 100	$74, 811
Black bass							1, 000	200
Bluefish	79, 300	$6, 700					30, 732	2, 079
Bowfin							2, 060	21
Butterfish							103, 751	2, 352
Cabio or crab eater							250	5
Carp							35, 944	814
Catfish and bullheads			2, 500	$250			177, 193	6, 591
Cero	1, 500	120						
Cod							146	5
Crappie	500	100					1, 350	150
Crevalle							300	6
Croaker							1, 070, 991	18, 324
Drum, black							3, 936	82
Drum, red, or redfish							29, 780	913
Eels	80	4					1, 030	57
Flounders	1, 140	100					274, 324	15, 799
Gizzard shad							58, 161	652
Grunts	1, 850	143						
Hake							380	19
Harvestfish or "starfish"							761, 259	18, 853
Hickory shad							163, 151	7, 139
King whiting or "kingfish"							50, 356	2, 656
Mullet							1, 081	72
Pigfish							7, 645	153
Pike							400	36
Pinfish or sailors choice							100	1
Pompano							2, 630	257
Porgies	125	10						
Sea bass	422, 325	27, 752					42	2
Shad							1, 664, 966	310, 043
Sheepshead, salt-water							6, 180	387
Snapper, red	2, 350	174						
Spadefish	240	20					12, 364	273
Spanish mackerel	3, 300	300					38, 910	3, 057
Spot							165, 663	2, 910
Squeteagues or "sea trout"							2, 017, 974	98, 950
Striped bass							156, 352	24, 116
Sturgeon							638	129
Suckers							7, 120	334
Sunfish							3, 475	189
Tripletail							143	6
White perch							129, 613	12, 230
Yellow perch							15, 621	917
Yellowtail							2, 577	131
Crabs, hard					839, 425	$16, 550		
Shrimp							1, 47[illegible]	53
Octopus	600	76						
Turtles							4	3
Total	513, 310	35, 499	2, 500	250	839, 425	16, 550	12, 370, 21[illegible]	605, 777

Fisheries of North Carolina, 1928—Continued

CATCH: BY GEAR—Continued

Species	Weirs		Wheels		Fyke nets		Dip nets, common	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives			12,000	$415	33,700	$577	75,000	$1,200
Black bass					3,870	600		
Bowfin	1,100	$55			5,175	164		
Carp	500	25			170,385	11,324		
Catfish and bullheads					78,200	3,187		
Crappie	100	8			190	25		
Croaker					50	1		
Eels					2,625	76		
Flounders					8,500	662		
Gizzard shad					26,300	528		
Hickory shad					3,200	159		
Mullet					560	14		
Pike					8,600	812		
Shad							1,470	402
Striped bass					5,870	986		
Suckers					2,700	102		
Sunfish					4,570	144		
White perch	2,200	165			47,310	2,837		
Yellow perch					95,745	7,759		
Crabs, hard							200	5
Crabs, soft							74,775	12,256
Total	3,900	253	12,000	415	497,550	29,957	151,445	13,863

Species	Bow nets		Drag nets		Push nets		Otter trawls			
							Fish		Shrimp	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	5,200	$225								
Cod							100	$3		
Croaker							30,000	560	10,000	$300
Drum, black							51	1		
Drum, red, or red fish							20	1		
Flounders							25,000	1,340	48,000	1,440
King whiting or "kingfish"									10,000	300
Pigfish									1,000	30
Shad	860	175								
Sheepshead, salt-water									1,000	30
Spot									10,000	300
Squeteagues or "sea trout"							2,000	115		
Striped bass	200	50								
Whiting							438	12		
Crabs, soft			25,802	$3,991						
Shrimp			85	5	11,875	$475	46	4	692,650	25,235
Total	6,260	450	25,887	3,996	11,875	475	57,655	2,036	772,650	27,635

Species	Box traps		Turtle traps		Eel pots		Spears	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp	1,000	$50						
Catfish and bullheads	1,000	50						
Eels					71,730	$5,589		
Flounders							38,562	$2,975
Striped bass	625	125						
Suckers	3,000	300						
White perch	1,820	182						
Yellow perch	20	2						
Turtles			300	$24				
Total	7,465	709	300	24	71,730	5,589	38,562	2,975

Species	Dredges				Tongs		Rakes		By hand	
	Oyster		Scallop							
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Crabs, hard			668	$100					6,624	$166
Crabs, soft			117,187	18,140						
Clams, hard, public					25,200	$5,425	299,000	$55,735	32	8
Oysters, market, public	2,025,527	$117,720			698,565	40,185			171,115	8,785
Oysters, market, private					4,480	800				
Oysters, seed, public	140,000	5,000			23,800	850				
Scallops, bay			534,474	46,165			859,650	79,680		
Terrapin									28	7
Total	2,165,527	122,720	652,329	64,405	752,045	47,260	1,158,650	135,415	177,799	8,966

Fisheries of North Carolina, 1928—Continued

OPERATING UNITS: BY COUNTIES

Items	Beaufort	Bertie	Brunswick	Camden	Carteret	Chowan	Craven	Cumberland
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	69		161		626		12	
On boats and shore—								
Regular	92		222		932	6	51	
Casual	156	35	51	6	763	122	42	40
Total	317	35	434	6	2,321	128	105	40
Vessels:								
Motor—								
5 to 10 tons			3		34		2	
11 to 20 tons					5			
21 to 30 tons					4			
31 to 40 tons			3		3			
41 to 50 tons			3		4			
51 to 60 tons			1		4			
61 to 70 tons			1		2			
71 to 80 tons					2			
Total			11		58		2	
Net tonnage			397		1,212		12	
Sail—								
5 to 10 tons	20				12			
11 to 20 tons	2				8			
21 to 30 tons	1							
Total	23				20			
Net tonnage	194				201			
Total vessels	23		11		78		2	
Total net tonnage	194		397		1,413		12	
Boats:								
Motor	67	8	28	2	454	50	17	
Other	102	6	50	3	652	20	45	25
Apparatus:								
Purse seines—								
Menhaden			8		29			
Yards			2,200		10,320			
Haul seines—								
Common	17	1	14		292		9	
Yards	5,995	1,600	3,075		23,401		3,090	
Long					25		2	
Yards					28,400		2,000	
Gill nets—								
Drift			5		27			23
Square yards			4,375		56,900			1,035
Stake	864				1,990		428	
Square yards	80,944				152,585		54,839	
Runaround	16		47		136		6	
Square yards	9,422		10,885		98,655		8,125	
Set				40	996	160		
Square yards				16,000	197,696	92,000		
Lines—								
Hand			36		63			
Hooks			72		117			
Trot with baits or snoods	55							
Baits or snoods	34,600							
Pound nets	184	64			172	539	8	
Fyke nets				8		13		
Dip nets			1		247			
Drag nets			1		80			
Otter trawls, shrimp			22		20			
Yards at mouth			458		257			
Box traps							20	
Eel pots	174		25		60	10	20	
Spears					10			
Dredges—								
Oyster	64				38			
Yards at mouth	190				127			
Scallop					773			
Yards at mouth					742			
Tongs	3				207			
Rakes			73		1,104			

Fisheries of North Carolina, 1928—Continued

OPERATING UNITS: BY COUNTIES—Continued

Items	Currituck	Dare	Gates	Hertford	Hyde	Lenoir	Martin	New Hanover
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	--------	3	--------	--------	7	--------	--------	--------
On boats and shore—								
Regular	119	522	--------	--------	108	--------	--------	267
Casual	187	63	12	8	44	43	85	98
Total	306	588	12	8	159	43	85	365
Vessels: Sail, 5 to 10 tons	--------	1	--------	--------	3	--------	--------	--------
Net tonnage	--------	7	--------	--------	23	--------	--------	--------
Total vessels	--------	1	--------	--------	3	--------	--------	--------
Total net tonnage	--------	7	--------	--------	23	--------	--------	--------
Boats:								
Motor	110	245	2	2	63	--------	2	10
Other	84	135	7	3	39	24	69	132
Apparatus:								
Purse seines—								
Other than menhaden	--------	3	--------	--------	--------	--------	--------	--------
Yards	--------	600	--------	--------	--------	--------	--------	--------
Haul seines—								
Common	111	37	--------	--------	3	3	3	35
Yards	24,579	15,200	--------	--------	800	270	900	4,635
Gill nets—								
Drift	--------	2	9	3	--------	--------	18	79
Square yards	--------	2,300	750	300	--------	--------	2,160	91,585
Stake	27	3,784	--------	--------	145	10	4	--------
Square yards	2,450	214,395	--------	--------	18,100	690	1,200	--------
Runaround	--------	29	--------	--------	11	--------	--------	102
Square yards	--------	31,400	--------	--------	4,980	--------	--------	22,766
Set	95	851	--------	--------	220	--------	1	2
Square yards	38,250	460,545	--------	--------	13,325	--------	100	1,350
Lines—								
Hand	--------	--------	--------	--------	--------	24	--------	8
Hooks	--------	--------	--------	--------	--------	24	--------	24
Trot with hooks	--------	--------	--------	--------	--------	24	--------	--------
Hooks	--------	--------	--------	--------	--------	600	--------	--------
Trot with baits or snoods	3	44	--------	--------	6	--------	--------	--------
Baits or snoods	4,200	68,000	--------	--------	6,000	--------	--------	--------
Pound nets	9	857	--------	10	86	--------	--------	--------
Weirs	--------	--------	--------	--------	--------	--------	16	--------
Wheels	--------	--------	--------	--------	--------	--------	5	--------
Fyke nets	472	--------	24	9	--------	--------	77	--------
Bow nets	--------	--------	--------	--------	--------	3	16	--------
Push nets	--------	--------	--------	--------	--------	--------	--------	11
Turtle traps	--------	4	--------	--------	--------	--------	--------	--------
Eel pots	755	250	--------	--------	18	--------	--------	--------
Spears	--------	--------	--------	--------	--------	--------	--------	33
Dredges—								
Oyster	--------	2	--------	--------	39	--------	--------	--------
Yards at mouth	--------	7	--------	--------	164	--------	--------	--------
Tongs	--------	11	--------	--------	71	--------	--------	--------
Rakes	--------	--------	--------	--------	35	--------	--------	87

Fisheries of North Carolina, 1928—Continued

OPERATING UNITS: BY COUNTIES—Continued

Items	Onslow	Pamlico	Pasquotank	Pender	Perquimans	Pitt	Tyrrell	Washington	Wayne
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels		58	8						
On boats and shore—									
Regular	120	98	39	25	23		14	18	
Casual	175	114	22	212	5	6	87	77	10
Total	295	270	69	237	28	6	101	95	10
Vessels:									
Motor, 5 to 10 tons		3	1						
Total		3	1						
Net tonnage		17	10						
Sail—									
5 to 10 tons		11	1						
11 to 20 tons		3	1						
Total		14	2						
Net tonnage		119	24						
Total vessels		17	3						
Total net tonnage		136	34						
Boats:									
Motor	46	90	15	1	16		38	15	3
Other	176	111	32	85	8	1	54	30	
Apparatus:									
Haul seines—									
Common	24	7	8	24		1		2	
Yards	2,815	3,000	600	3,170		200		1,600	
Long		2							
Yards		2,100							
Gill nets—									
Drift	23			25				10	
Square yards	6,280			19,500				3,250	
Stake		998		1	30		570		
Square yards		84,320		185	1,980		34,500		
Runaround	288	1		25					
Square yards	94,172	950		7,696					
Set	12	66	469	1	391		190	172	
Square yards	20,555	15,930	167,145	65	226,800		141,000	101,995	
Lines—									
Hand	60								
Hooks	120								
Trot with baits or snoods		39							
Baits or snoods		19,500							
Pound nets		224	31		55		101	66	
Fyke nets			72				48		
Dip nets	35							4	
Otter trawls, fish			1						
Yards at mouth			40						
Box traps									30
Eel pots	55	92			35		50		
Spears	40								
Dredges—									
Oyster		54	3						
Yards at mouth		127	11						
Tongs	67	120	1	10			2		
Rakes	28			110					

Fisheries of North Carolina, 1928—Continued

CATCH: BY COUNTIES

Species	Beaufort		Bertie		Brunswick		Camden		Carteret	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	499,313	$7,956	494,890	$7,375			700	$13	9,550	$370
Bluefish					600	$60			506,336	28,758
Bonito									5,000	75
Bowfin							100	1		
Butterfish									24,694	644
Carp	71,914	878					300	11		
Catfish and bullheads	52,174	758			750	45	600	22		
Cero									1,500	120
Crevalle									300	6
Croaker	387,385	5,918			10,900	370	100	2	3,637,360	49,790
Drum, black					90	7				
Drum, red, or redfish	5,400	70			1,000	80			132,773	2,487
Eels	12,675	565			1,500	180	25	1	5,000	500
Flounders	22,370	1,080			53,000	1,840	50	3	30,170	1,425
Gizzard shad							60	1		
Grunts									1,850	143
Harvest fish or "starfish"	9,200	230							168,516	5,832
Hickory shad	29,094	1,706	275	11			200	10	74,325	3,315
King whiting or "kingfish"					10,250	320			488,035	21,728
Menhaden					30,717,800	153,624			68,584,555	277,374
Mullet	12,365	1,193			233,500	12,900	14	1	870,148	48,832
Pigfish					1,250	50			210,760	3,189
Pike							14	1		
Pompano									3,217	349
Porgies									125	10
Sea bass					15,425	1,542			274,400	16,800
Shad	101,017	17,945	63,553	7,123	3,650	800	52,506	9,637	55,810	14,094
Sheepshead, salt-water					1,645	75			10,650	470
Snapper, red									2,350	174
Spadefish									1,790	67
Spanish mackerel									116,134	9,599
Spot	20,685	417			11,250	400			1,753,425	32,276
Squeteagues or "sea trout"	109,778	3,785			2,650	290			1,763,253	102,257
Striped bass	31,004	3,538	9,715	1,460	1,335	200	200	28	12,930	1,785
Sturgeon	325	40							460	105
Suckers							400	12		
Sunfish	610	26					40	1		
White perch	10,142	982	250	25			1,800	113	200	10
Yellow perch	9,284	606					700	33		
Yellowtail					200	15			1,000	20
Crabs, hard	214,660	4,055			200	5			668	100
Crabs, soft									628,276	96,265
Shrimp					587,735	19,630			145,000	6,490
Clams, hard, public					58,920	12,900			148,832	25,358
Oysters, market, public	526,183	42,175			1,400	150			1,397,963	54,085
Oysters, market, private									4,480	800
Scallops, bay									1,394,124	125,845
Octopus									600	76
Total	2,125,578	93,923	568,683	15,994	31,715,050	205,483	57,809	9,890	82,466,559	931,623

Fisheries of North Carolina, 1928—Continued

CATCH: BY COUNTIES—Continued

Species	Chowan		Craven		Cumberland		Currituck		Dare	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	3,403,200	$42,630	19,800	$650			17,733	$474	296,097	$7,369
Black bass							75,567	10,984	13,760	2,130
Bluefish			400	16			10,000	1,200	187,623	12,410
Bonito							600	30	2,350	55
Bowfin							10,770	227	3,520	35
Butterfish			1,820	57			1,500	60	54,880	1,096
Cabio or crab eater									250	5
Carp	5,450	222	8,300	166			574,190	35,747	21,106	782
Catfish and bullheads	106,040	4,170	8,000	158			163,578	5,422	59,644	1,752
Cod									196	7
Crappie	420	60	1,380	74			454	5	12	1
Crevalle							480	24		
Croaker			542,125	7,051			32,875	1,295	897,366	16,254
Drum, black			100	2					6,876	178
Drum, red, or redfish			1,500	23			12,000	600	30,523	779
Eels	2,000	200	400	32			34,244	2,503	2,394	188
Flounders			6,050	282			16,527	1,041	249,015	14,803
Garfish			1,000	5						
Gizzard shad	50,000	500					41,020	694	3,961	64
Hake									380	19
Harvest fish or "star-fish"			29,860	898			8,500	300	337,853	6,696
Hickory shad	44,470	2,875	20,220	1,107			1,367	70	72,702	3,204
King whiting or "king-fish"							85,500	4,275	113,615	4,174
Mullet			34,850	2,825			15,100	755	28,672	1,650
Pigfish			200	4			12,000	600	1,097	38
Pike	100	10	630	32			13,020	1,301	25	2
Pinfish or sailors choice									100	1
Pollock									150	5
Pompano							430	60	508	60
Sea bass									1,542	122
Shad	105,432	21,500	44,124	8,698	7,300	$1,720	44,690	8,194	2,007,901	365,368
Sheepshead, salt-water			900	60					6,097	329
Spadefish									2,797	63
Spanish mackerel			835	76			4,000	600	31,931	2,204
Spot			29,850	572			17,400	870	294,732	5,840
Squeteagues or "sea trout"			140,625	6,705			258,412	18,521	2,003,275	126,213
Striped bass	40,720	8,075	10,776	1,317			42,457	6,796	191,227	26,407
Sturgeon									4,033	774
Suckers	5,100	260	300	4			1,240	27	555	14
Sunfish	770	110					14,780	232	2,935	64
Tripletail									143	6
Tuna									71	4
White perch	73,700	6,403	4,740	489			192,384	10,042	71,762	3,437
Yellow perch	7,000	400	1,680	83			114,920	7,649	8,134	359
Yellowtail							13,351	614	10,285	509
Crabs, hard							10,000	150	410,000	8,200
Shrimp									1,478	53
Oysters, market, public									18,550	1,725
Terrapin									28	7
Turtles									347	27
Total	3,844,402	87,415	910,465	31,386	7,300	1,720	1,841,089	121,362	7,452,498	615,482

Fisheries of North Carolina, 1928—Continued

CATCH: BY COUNTIES—Continued

Species	Gates		Hertford		Hyde		Lenoir	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives			50,000	$562	30,400	$605	100	$5
Bluefish					22,560	1,840		
Bowfin	500	$12	175	4				
Butterfish					21,850	490		
Carp	125	3	160	4	400	8		
Catfish and bullheads	600	12	400	8			2,500	250
Crappie							705	141
Croaker					533,900	8,465		
Drum, black					1,500	30		
Drum, red, or redfish					42,850	1,270		
Eels							80	4
Flounders					1,950	90		
Harvestfish or "starfish"					172,700	3,655		
Hickory shad			50	1	4,660	180	520	51
King whiting or "kingfish"					13,525	645		
Mullet	400	10	360	9	23,182	1,820		
Pigfish					10,750	215		
Pompano					2,280	228		
Shad	1,425	205	566	75	19,484	3,910	4,284	1,145
Sheepshead, salt-water					1,080	108		
Spadefish					8,000	165		
Spanish mackerel					12,050	1,220		
Spot					43,400	877		
Squeteagues or "sea trout"					314,195	12,245		
Striped bass			50	5	600	60	540	135
Sturgeon							232	10
Suckers							200	30
Sunfish							30	6
White perch	300	21	105	7			8	2
Yellow perch	200	13	45	3			4	1
Crabs, hard					43,525	675		
Clams, hard, public					8,000	1,500		
Oysters, market, public					150,570	10,825		
Oysters, seed, public					163,800	5,850		
Total	3,550	276	51,911	678	1,647,211	56,976	9,203	1,780

Species	Martin		New Hanover		Onslow		Pamlico	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	382,700	$8,090			84,500	$1,690	55,835	$800
Bluefish			520	$37	14,700	605	5,600	228
Bowfin	1,550	72						
Butterfish					400	10	6,775	217
Carp	6,000	200					1,450	17
Catfish and bullheads	3,260	106					130	7
Crappie	100	8						
Croaker			4,475	179	10,333	273	678,085	10,916
Drum, red, or redfish			4,942	284	1,400	101	2,460	90
Eels					5,000	600	5,275	390
Flounders			17,730	1,773	7,187	575	19,225	885
Harvestfish or "starfish"							55,165	1,926
Hickory shad	300	3	15,100	1,206			93,785	3,215
King whiting or "kingfish"			80	5	68,240	2,850	250	10
Mullet			376,017	25,434	618,129	31,735	6,060	505
Pigfish			8,576	538	1,900	46	985	20
Pike							20	2
Pompano			700	100			510	44
Sea bass			4,500	450	128,000	8,960		
Shad	1,680	288	52,738	11,726	1,470	402	96,958	19,705
Sheepshead, salt-water					920	55	690	42
Spadefish							1,135	37
Spanish mackerel			5,900	885	1,500	125	1,655	145
Spot			125,003	6,817	317,403	7,705	90,887	1,383
Squeteagues or "sea trout"			16,142	2,326	48,191	5,445	458,770	18,255
Striped bass	2,400	310	2,040	305	1,040	130	11,178	1,705
Sturgeon			3,385	350				
White perch	16,500	948					630	81
Yellow perch	100	8					40	3
Crabs, hard			6,624	166			161,240	3,470
Crabs, soft					668	100		
Shrimp			73,625	2,945	4,300	300		
Clams, hard, public			53,280	11,085	25,600	4,275		
Oysters, market, public			62,300	6,125	60,102	5,075	647,269	42,995
Total	414,590	10,033	833,677	72,736	1,400,983	71,057	2,402,062	107,093

Fisheries of North Carolina, 1928—Continued

CATCH: BY COUNTIES—Continued

Species	Pasquotank		Pender		Perquimans	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	82,360	$2,246			72,758	$1,260
Black bass	109	19				
Bluefish	15	1	5,625	$675		
Bowfin	1,404	24			200	2
Butterfish	47	2				
Carp	5,580	217			1,460	67
Catfish and bullheads	36,207	1,335			9,370	297
Cod	100	3				
Crappie	333	40				
Croaker	37,060	687	3,200	160	50	1
Drum, black	121	3				
Drum, red, or redfish	65	3	2,522	155		
Eels	2,600	75			2,240	179
Flounders	28,845	1,560	715	50	895	53
Gizzard shad	8,894	175			4,700	95
Hickory shad	14,336	707			15,700	870
King whiting or "kingfish"	741	46				
Mullet	631	46	281,462	15,880	163	13
Pigfish			2,250	135		
Pike	2,659	215			125	10
Pompano			750	85		
Shad	165,400	29,321	18,000	4,100	160,268	28,260
Sheepshead, salt-water			200	25		
Spadefish	34	1				
Spanish mackerel			1,875	225		
Spot			250,314	9,025		
Squeteagues or "sea trout"	4,883	279	7,265	985	20	2
Striped bass	40,679	5,366			21,800	3,500
Suckers	3,344	126			900	31
Sunfish	2,132	58			30	1
White perch	49,485	4,428			3,025	297
Whiting	438	12				
Yellow perch	8,905	360			468	27
Yellowtail	30	1				
Shrimp	46	4	33,165	1,025		
Clams, hard, public			29,600	6,050		
Oysters, market, public	16,100	2,300	11,970	935		
Total	513,583	49,660	648,913	39,510	294,172	34,965

Species	Pitt		Tyrrell		Washington		Wayne	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	10,000	$455	776,000	$8,580	1,522,095	$19,597		
Black bass			1,000	200				
Bowfin			1,900	19				
Carp			12,500	620	44,885	1,485	1,000	$50
Catfish and bullheads			28,000	1,120	10,980	560	1,000	50
Crappie			1,000	100				
Croaker			50	1				
Eels			3,300	336				
Flounders	285	20	1,200	70				
Gizzard shad			1,000	10				
Hickory shad			2,560	203	7,520	535		
Mullet			500	75				
Pike			2,000	180				
Shad	4,725	900	18,280	3,810	87,154	14,081		
Striped bass	500	75	13,800	2,750	71,790	7,863	625	125
Suckers			600	43			3,000	300
Sunfish			900	27				
White perch	330	50	9,635	1,310	23,360	1,722		
Yellow perch			23,600	2,550				
Oysters, market, public			2,800	300				
Total	15,840	1,500	900,625	22,304	1,767,784	45,843	5,625	525

INDUSTRIES RELATED TO THE FISHERIES

Transporting trade.—In 1928 there were 45 persons in North Carolina engaged primarily in transporting the catch of fish. In this trade 28 motor vessels having a total capacity of 295 net tons were operated. The size of vessel in most popular use ranged from 5 to 10 net tons.

Wholesale trade.—There were 85 wholesale establishments in North Carolina engaged primarily in handling fresh and frozen products. This is 37 per cent of the total number of such establishments in the South Atlantic section. They employed 440 persons who received $138,799 in salaries and wages. Of the total number of establishments, Carteret County accounted for 36 and Beaufort County, 9.

Prepared and by products trade.—In 1928 there were 21 establishments in North Carolina engaged primarily in the manufacture of prepared fishery products or by-products. This is 35 per cent of the total number in the South Atlantic section. They employed 260 persons who received $141,580 in salaries and wages. The products manufactured consisting principally of menhaden products and canned oysters, were valued at $1,160,482. Detailed statistics of most of the items manufactured may be obtained from "Fishery Industries of the United States, 1928," Bureau of Fisheries Document No. 1067.

In addition to the above, 2,498,755 pounds of salted and smoked fish, valued at $69,993 were prepared by the fishermen.

Industries related to the fisheries of North Carolina, 1928

TRANSPORTING

Items	Number	Items	Number
Men on transporting vessels	45	Transporting vessels (motor)—Contd. 21 to 30 tons	2
Transporting vessels (motor):			
5 to 10 tons	18	Total vessels	28
11 to 20 tons	8	Total net tonnage	295

WHOLESALE FISHERY TRADE

Items	Beaufort	Brunswick	Carteret	Currituck and Pasquotank	Dare	New Hanover and Pender	Onslow	Pamlico and Craven	Total
Establishments	9	6	36	7	7	7	5	8	85
Persons engaged:									
Proprietors	12	8	51	8	10	8	6	12	115
Salaried employees	4	8	33	20	2	2		13	82
Wage earners	67	40	73	8	21	11	5	18	243
Paid to salaried employees	$1, 980	$3, 100	$30, 980	$14, 650	$1, 000	$1, 664		$7, 840	$61, 214
Paid to wage earners	22, 030	9, 100	26, 558	5, 300	4, 175	4, 972	$1, 050	4, 400	77, 585
Total salaries and wages	24, 010	12, 200	57, 538	19, 950	5, 175	6, 636	1, 050	12, 240	138, 799

Industries related to the fisheries of North Carolina, 1928—Continued

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS

Items	Number	Products [1]	Quantity	Value
Establishments	21	Salted:		
Persons engaged:		Alewives pounds	1,058,465	$18,711
Proprietors	39	Mullet do	565,000	45,404
Salaried employees	41	Spot do	146,000	10,845
Wage earners	180	Canned oysters standard cases [2]	29,161	145,102
		Menhaden:		
Paid to salaried employees	$49,467	Dry scrap tons	4,492	240,355
Paid to wage earners	92,113	Acidulated scrap do	7,333	186,476
		Fish meal do	3,854	240,425
Total salaries and wages	141,580	Oil gallons	633,806	248,897
		Miscellaneous products [3]		24,267
		Total		1,160,482

PRODUCTS PREPARED BY THE FISHERMEN

Items	Pounds	Value
Salted:		
Alewives	2,296,605	$53,078
Mullet	196,150	16,520
Spot	3,000	245
Total	2,495,755	69,843
Smoked alewives	3,000	150
Grand total	2,498,755	69,993

[1] Includes salted products prepared by 14 firms whose activities were principally in the wholesale fishery trade.
[2] A standard case contains 4 dozen 5-ounce cans of oysters.
[3] Includes canned alewife roe, oyster-shell products, and porpoise oil.

SOUTH CAROLINA

The fisheries of South Carolina in 1928 employed 13 per cent of the total number of fishermen and accounted for 3 per cent of the total catch of the South Atlantic section. The fisheries and industries related to the fisheries employed 2,540 persons, which is 16 per cent greater than the number employed during 1927. Of the total, 1,505 were fishermen, 143 were employed on transporting vessels, 236 in the wholesale trade, and 656 in the prepared-products and by-products industries.

The total catch amounted to 7,432,414 pounds, valued at $316,814. This is a decrease of 11 per cent in the catch and 10 per cent in the value of the catch as compared with the catch and its value for 1927. Of the total value of the catch, that for oysters accounted for 51 per cent; shad, 21 per cent; and shrimp and mullet, each, 6 per cent. Of the total production, that for oysters accounted for 78 per cent; shrimp 6 per cent; and shad and sea bass, each, 4 per cent.

OPERATING UNITS BY GEAR

The catch of fishery products in South Carolina during 1928 was taken by 1,505 fishermen who used 4 motor vessels, 1,004 motor and other small boats, and 10 major types of gear. The vessels had a combined capacity of 53 net tons. The fisheries accounting for the greatest number of persons were the grab fishery employing 504 fishermen, the tong fishery employing 337 fishermen, and the set gill-net fishery employing 272 fishermen.

CATCH BY GEAR

Five types of gear accounted for 91 per cent of the fish taken in the fisheries of South Carolina during 1928. Listed in order of their importance they were grabs, which accounted for 47 per cent of the catch; tongs, 28 per cent; otter trawls used for shrimp, 6 per cent; and haul seines and lines, each, 5 per cent. The catch by grabs and tongs was almost exclusively oysters; that by otter trawls exclusively shrimp; that by haul seines principally mullet and spot; and that by lines mainly sea bass.

OPERATING UNITS BY COUNTIES

Beaufort County was foremost in the number of persons fishing, accounting for 37 per cent of the total. Charleston County followed with 23 per cent. Only four fishing vessels were operated in the State, one of which was in Beaufort County and three in Charleston County. Beaufort County led in the number of motor and other small fishing boats accounting for 54 per cent of the total. Charleston County followed with 22 per cent.

CATCH BY COUNTIES

Fishing was prosecuted in the marine waters of five counties in South Carolina during 1928. Ranked according to value the fisheries of Beaufort County were most important accounting for 53 per cent of the catch and 39 per cent of the total value of the catch. Charleston County was next in importance accounting for 36 per cent of the catch and 32 per cent of the value of the catch. Other counties listed in order of their importance with respect to the value of the catch were Georgetown, Horry, and Colleton.

Fisheries of South Carolina, 1928

OPERATING UNITS: BY GEAR

Items	Haul seines, common	Gill nets				Lines		Cast nets
		Drift	Stake	Runaround	Set	Hand	Trot with baits or snoods	
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels						17		
On boats and shore—								
Regular	2				20	45	8	
Casual	254	205	25	30	252	5		3
Total	256	205	25	30	272	67	8	3
Vessels:								
Motor—								
5 to 10 tons						2		
Total vessels						2		
Total net tonnage						17		
Boats:								
Motor	1	17	3	2	5	5		
Other	50	100	12	13	158	10	4	3
Apparatus:								
Number	39	118	39	16	332	84	4	3
Length, yards	4,325							
Square yards		96,367	11,215	4,765	107,315			
Hooks, baits or snoods						417	300	

Fisheries of South Carolina, 1928—Continued

OPERATING UNITS: BY GEAR

Items	Otter trawls, shrimp	Spears	Dredges, oyster	Tongs	Rakes	Grabs	By hand	Total, exclusive of duplication
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:								
On vessels			9					26
On boats and shore—								
Regular	10			328		415	50	552
Casual	8	34		9	60	89	96	927
Total	18	34	9	337	60	504	146	1,505
Vessels:								
Motor—								
5 to 10 tons								2
11 to 20 tons			2					2
Total vessels			2					4
Total net tonnage			36					53
Boats:								
Motor	9			3		10	1	43
Other		16		334	20	512	98	961
Apparatus:								
Number	9	34	4	301	60	397		
Yards at mouth	453		16					

CATCH: BY GEAR

Species	Haul seines, common		Gill nets					
			Drift		Stake		Anchor	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives			2,000	$100				
Croakers	2,400	$120						
Drum, red, or redfish	2,060	180						
Flounders	3,200	320						
Hickory shad			5,594	811	7,400	$1,000	50	$5
King whiting, or "kingfish"	23,500	1,200						
Mullet	259,340	15,725						
Shad			102,722	22,092	39,307	9,156	52,630	9,510
Spot	82,600	2,575						
Squeteagues, or "sea trout"	11,075	870						
Sturgeon			20,360	2,200			3,000	1,000
Terrapin	5,099	2,234						
Total	389,274	23,224	130,676	25,203	46,707	10,156	55,680	10,515

Species	Gill nets				Lines			
	Runaround		Set		Hand		Trot with bait or snoods	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bluefish					3,500	$280		
Carp	1,800	$54						
Catfish and bullheads	2,100	63			300	24		
Croakers	400	20			9,300	490		
Drum, black	200	6			3,350	100		
Drum, red, or redfish	310	16			2,500	195		
Flounders	500	20						
Grunts					5,625	450		
Hickory shad			1,304	$160				
King whiting, or "kingfish"					38,000	4,090		
Mullet	27,640	1,550						
Sea bass					271,000	21,650		
Shad			125,578	25,556				
Sharks					6,300	500		
Spot	7,230	250						
Squeteagues, or "sea trout"	2,445	160			6,000	370		
Squirrelfish					5,500	440		
Crabs, hard							2,370	$500
Octopus					2,000	400		
Total	42,625	2,139	126,882	25,716	353,375	28,989	2,370	500

Fisheries of South Carolina, 1928—Continued

CATCH: BY GEAR—Continued

Species	Cast nets		Otter trawls, shrimp		Spears		Oyster dredges	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Flounders					17,000	$1,700		
Mullet	4,000	$200						
Shrimp			431,441	$17,526				
Oysters, market, public							21,000	$570
Oysters, market, private							42,000	1,080
Total	4,000	200	431,441	17,526	17,000	1,700	63,000	1,650

Species	Tongs		Rakes		Grabs		By hand	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Clams, hard, public	312	$45	24,800	$3,820			1,072	$140
Oysters, market, public	1,753,857	52,388			3,169,453	$84,864	133,000	6,005
Oysters, market, private	340,781	9,280			337,624	8,680		
Terrapin							8,485	4,074
Total	2,094,950	61,713	24,800	3,820	3,507,077	93,544	142,557	10,219

OPERATING UNITS: BY COUNTIES

Items	Beaufort	Charleston	Colleton	Georgetown	Horry
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	3	23			
On boats and shore—					
Regular	356	194		2	
Casual	193	124	104	289	217
Total	552	341	104	291	217
Vessels:					
Motor—					
5 to 10 tons		2			
11 to 20 tons	1	1			
Total vessels	1	3			
Total net tonnage	17	36			
Boats:					
Motor	3	19		21	
Other	532	198	61	117	53
Apparatus:					
Haul seines, common	13	7		6	13
Yards	975	450		850	2,050
Gill nets—					
Drift	23	5	2	66	22
Square yards	9,200	867	330	55,170	30,800
Stake				6	33
Square yards				9,070	2,145
Runaround				14	2
Square yards				4,365	400
Set	48	77	103	104	
Square yards	14,400	27,600	34,100	31,215	
Lines—					
Hand		84			
Hooks		417			
Trot, with baits or snoods		4			
Baits or snoods		300			
Cast nets	3				
Otter trawls, shrimp	2	3		4	
Yards at mouth	100	153		200	
Spears				34	
Dredges, oyster	2	2			
Yards at mouth	8	8			
Tongs	203	94	4		
Rakes				20	40
Grabs	280	117			

Fisheries of South Carolina, 1928—Continued

CATCH: BY COUNTIES

Species	Beaufort		Charleston		Colleton		Georgetown		Horry	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives							2,000	$100		
Bluefish			3,500	$280						
Carp							1,800	54		
Catfish and bullheads			300	24			2,100	63		
Croakers			9,300	490			900	45	1,900	$95
Drum, black			3,350	100			200	6		
Drum, red, or red fish			2,500	195			610	36	1,760	160
Flounders							18,500	1,820	2,200	220
Grunts			5,625	450						
Hickory shad	250	$25	450	45	100	$10	6,548	996	7,000	900
King whiting or "king fish"			38,000	4,090			2,500	150	21,000	1,050
Mullet	4,000	200					56,390	3,295	230,590	13,980
Sea bass			271,000	21,650						
Shad	22,445	3,424	47,355	8,562	63,000	11,390	148,377	35,498	39,060	7,440
Sharks			6,300	500						
Spot							17,130	575	72,700	2,250
Squeteagues or "sea trout"			6,000	370			3,790	270	9,730	760
Squirrelfish			5,500	440						
Sturgeon					3,000	1,000	20,360	2,200		
Crabs, hard			2,370	500						
Shrimp	361,941	14,476	65,000	2,600			4,500	450		
Clams, hard, public	760	95	624	90			800	70	24,000	3,750
Oysters, market, public	3,520,020	101,189	1,509,396	39,258	3,094	80	44,800	3,300		
Oysters, market, private			720,405	19,040						
Octopus			2,000	400						
Terrapin	9,454	4,758	4,130	1,550						
Total	3,918,870	124,167	2,703,105	100,634	69,194	12,480	331,305	48,928	409,940	30,605

INDUSTRIES RELATED TO THE FISHERIES

Transporting trade.—In 1928 there were 143 persons in South Carolina engaged primarily in transporting the catch of fish. In this trade 22 motor vessels and 40 sailing vessels, having a combined capacity of 635 net tons, were operated. The size of vessel in most popular use ranged from 5 to 10 net tons.

Wholesale trade.—There were 18 wholesale establishments in South Carolina engaged primarily in handling fresh and frozen products. This is 8 per cent of the total number of such establishments in the South Atlantic section. These establishments employed 236 persons who received $56,468 in salaries and wages. Beaufort County alone accounted for 10 of these establishments.

Prepared and by-products trade.—There were 18 establishments in South Carolina in 1928 engaged primarily in the manufacture of fishery products or by-products. This is 30 per cent of the total number in the South Atlantic section. They employed 656 persons who received $159,720 in salaries and wages. The products manufactured, consisting principally of canned oysters and shrimp, were valued at $1,028,113. Detailed statistics of most of the items manufactured may be obtained from Fishery Industries of the United States, 1928, Bureau of Fisheries Document No. 1067.

In addition to the above, 163,140 pounds of salted fish and sturgeon caviar, valued at $10,867, were prepared by the fishermen.

Industries related to the fisheries of South Carolina, 1928

TRANSPORTING

Items	Number	Items	Number
Men on transporting vessels	143	Transporting vessels—Continued.	
Transporting vessels:		Sail—	
Motor—		5 to 10 tons	28
5 to 10 tons	11	11 to 20 tons	11
11 to 20 tons	11	21 to 30 tons	1
Total	22	Total	40
Net tonnage	246	Net tonnage	389
		Total vessels	62
		Total net tonnage	635

WHOLESALE FISHERY TRADE

Items	Beaufort County	Charleston, Colleton, and Horry Counties	Total
Establishments	10	8	18
Persons engaged:			
Proprietors	14	9	23
Salaried employees	5	22	27
Wage earners	164	22	186
Paid to salaried employees	$4,200	$29,600	$33,800
Paid to wage earners	15,568	7,100	22,668
Total salaries and wages	19,768	36,700	56,468

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS

Items	Number	Products	Quantity	Value
Establishments	18	Canned:		
Persons engaged:		Oysters.....standard cases [1]	133,302	$729,420
Proprietors	19	Shrimp—		
Salaried employees	68	Dry pack.....do	4,008	23,653
Wage earners	569	Wet pack.....do	24,673	153,991
		Oyster-shell products:		
Paid to salaried employees	$53,920	Poultry feed.....tons	11,040	116,410
Paid to wage earners	105,800	Lime.....do	671	4,639
Total salaries and wages	159,720	Total		1,028,113

PRODUCTS PREPARED BY THE FISHERMEN

Items	Pounds	Value
Salted:		
Mullet	130,300	$9,120
Spot	32,700	1,635
Sturgeon caviar	140	112
Total	163,140	10,867

[1] A standard case contains forty-eight 5-ounce cans of oysters, forty-eight 5-ounce cans in the dry pack, or forty-eight 5¾-ounce cans in the wet pack of shrimp.

GEORGIA

The fisheries of Georgia in 1928 employed 11 per cent of the total number of fishermen and accounted for 16 per cent of the total catch of the South Atlantic section. The fisheries and industries related to the fisheries employed 2,224 persons, which is 15 per cent greater than the number employed during 1927. Of the total, 1,288 were fishermen, 44 were employed on transporting vessels, 395 in the wholesale trade, and 497 in the prepared-products and by-products industries.

The total catch amounted to 42,068,780 pounds, valued at $866,287. This is a decrease of 12 per cent in the catch and an increase of 24 per cent in the value of the catch as compared with the catch and its value for 1927. Of the total value of the catch, that for shrimp accounted for 63 per cent; menhaden, 13 per cent; and oysters, 6 per cent. Of the total production, that of menhaden accounted for 71 per cent and shrimp, 23 per cent.

OPERATING UNITS BY GEAR

The catch of fishery products in Georgia during 1928 was taken by 1,288 fishermen, 26 motor vessels, 737 motor and other small boats, and 10 major types of gear. The vessels had a combined capacity of 351 net tons. The fisheries accounting for the greatest number of persons were the otter trawl fishery, employing 493 fishermen, the drift gill-net fishery, employing 391 fishermen, and the grab fishery, employing 258 fishermen.

CATCH BY GEAR

Two types of gear accounted for 95 per cent of the fishery products taken in the fisheries of Georgia during 1928. Listed in order of their importance they were purse seines which accounted for 71 per cent of the catch, and otter trawls, used for shrimp, accounted for 24 per cent of the catch. The catch by purse seines was exclusively menhaden and that by otter trawls, chiefly shrimp.

OPERATING UNITS BY COUNTIES

Chatham County was foremost in the number of persons fishing, accounting for 34 per cent of the total. Glynn County followed with 31 per cent. Other counties employing a considerable number of fishermen, listed in order of their importance in this respect, were Camden, McIntosh, and Bryan. Glynn County accounted for 54 per cent of the total number of fishing vessels and Chatham County 23 per cent. Chatham County led in the number of motor and other small fishing boats, accounting for 38 per cent of the total. Glynn County followed with 27 per cent.

CATCH BY COUNTIES

Fishing was prosecuted in the marine waters of nine counties in Georgia during 1928. Ranked according to value the fisheries of Glynn County were most important, accounting for 18 per cent of the total catch and 51 per cent of the total value of the catch. Camden County was next in importance, accounting for 73 per cent of the catch and 19 per cent of the value of the catch. Other important counties listed in order of their importance with respect to value of the catch were Chatham, McIntosh, and Bryan.

6881—31——13

Fisheries of Georgia, 1928

OPERATING UNITS: BY GEAR

Items	Purse seines, menhaden	Haul seines, common	Gill nets				Lines	
			Drift	Stake	Anchor	Run-around	Hand	Trot with baits or snoods
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:								
On vessels	87						8	
On boats and shore—								
Regular		22	61		8	7		15
Casual		4	330	35	22	2		17
Total	87	26	391	35	30	9	8	32
Vessels:								
Motor—								
11 to 20 tons							1	
41 to 50 tons	1							
51 to 60 tons	1							
61 to 70 tons	1							
Total	3						1	
Net tonnage	166						14	
Boats:								
Motor		1	6		3	1		
Other		8	171	35	20	7		32
Apparatus:								
Number	3	13	191	159	20	9	8	77
Length, yards	900	1,405						
Square yards			139,495	3,816	4,792	3,565		
Hooks, baits, or snoods							16	5,404

Items	Fyke nets	Dip nets, drop	Cast nets	Otter trawls, shrimp	Tongs	Grabs	By hand	Total, exclusive of duplication
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:								
On vessels				51				146
On boats and shore—								
Regular	15	4	17	442	142	220	15	686
Casual		2	1		37	38	20	456
Total	15	6	18	493	179	258	35	1,288
Vessels:								
Motor—								
5 to 10 tons				21				21
11 to 20 tons				1				2
41 to 50 tons								1
51 to 60 tons								1
61 to 70 tons								1
Total				22				26
Net tonnage				171				351
Boats:								
Motor				216	14	14		229
Other	15	6	18		165	243		508
Apparatus:								
Number	50	6	18	238	179	258		
Yards at mouth				13,175				

Fisheries of Georgia, 1928—Continued

CATCH: BY GEAR

Species	Gill nets							
	Drift		Stake		Anchor		Runaround	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Catfish and bullheads							800	$40
Croakers					10,000	$1,000	300	30
Drum, black					3,000	150	250	20
Drum, red, or redfish					5,000	250	1,000	125
Flounders					2,500	300	500	63
Hickory shad	48,752	$5,600	4,800	$445				
King whiting or "kingfish"					1,500	150	2,000	200
Mullet					7,500	600	6,930	575
Shad	297,867	69,326	11,700	2,650	7,700	1,700		
Sheepshead, salt-water					670	100	800	100
Spot					7,500	600	400	40
Squeteagues or "sea trout"					10,616	1,580	7,500	987
Striped bass					340	50	250	45
Sturgeon	1,750	350						
Tripletail					1,050	150	500	62
Total	348,369	75,276	16,500	3,095	57,376	6,630	21,230	2,287

Species	Lines				Purse seines, menhaden		Haul seines, common		Fyke nets	
	Hand		Trot with baits or snoods							
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bluefish	50,000	$5,000								
Catfish and bullheads	60	15							140,000	$14,000
Groupers	8,274	414								
Jewfish	3,200	160								
Menhaden					30,030,000	$113,310				
Muttonfish	1,650	132								
Sea bass	85,200	8,380								
Snapper, red	22,500	1,920								
Striped bass	150	12								
Crabs, hard			238,200	$6,220						
Terrapin			11,100	3,527			10,838	$3,494		
Total	171,034	16,033	249,300	9,747	30,030,000	113,310	10,838	3,494	140,000	14,000

Species	Dip nets, drop		Cast nets		Otter trawls, shrimp	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Flounders					12,690	$900
King whiting or "kingfish"					52,500	2,100
Mullet			42,895	$3,000		
Crabs, hard	19,200	$720			311,941	12,476
Shrimp					9,526,044	545,354
Total	19,200	720	42,895	3,000	9,903,175	560,830

Species	Tongs		Grabs		By hand	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Clams, hard, public					800	$125
Oysters, market, public	94,710	$5,700	67,830	$3,826	37,100	3,450
Oysters, market, private	296,380	13,725	552,405	27,969		
Terrapin					9,638	3,070
Total	391,090	19,425	620,235	31,795	47,538	6,645

Fisheries of Georgia, 1928—Continued

OPERATING UNITS: BY COUNTIES

Items	Bryan	Camden	Chatham	Charlton	Glynn	Liberty	McIntosh	Tattnall	Wayne
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:									
On vessels		89	19		33		5		
On boats and shore—									
Regular		37	274		261	21	93		
Casual	70	31	149	10	111		25	35	25
Total	70	157	442	10	405	21	123	35	25
Vessels:									
Motor—									
5 to 10 tons		1	5		13		2		
11 to 20 tons			1		1				
41 to 50 tons		1							
51 to 60 tons		1							
61 to 70 tons		1							
Total vessels		4	6		14		2		
Total net tonnage		175	52		108		16		
Boats:									
Motor		18	55		132		24		
Other	40	26	207	7	81	21	77	35	14
Apparatus:									
Purse seines, menhaden		3							
Yards		900							
Haul seines, common			2		9		2		
Yards			150		1,055		200		
Gill nets—									
Drift	31	26	50	7	39		12		26
Square yards	21,000	3,900	77,600	1,050	20,215		7,930		7,800
Stake								159	
Square yards								3,816	
Anchor	10				9		1		
Square yards	2,200				2,400		192		
Runaround	1		5		3				
Square yards	200		2,000		1,365				
Lines—									
Hand			8						
Hooks			16						
Trot with baits or snoods			63		14				
Baits or snoods			2,304		3,100				
Fyke nets							50		
Dip nets, drop			6						
Cast nets			10		2		6		
Otter trawls, shrimp		19	47		141		31		
Yards at mouth		960	2,550		7,990		1,675		
Tongs			147		20	8	4		
Grabs			166		16	21	55		

CATCH: BY COUNTIES

Species	Bryan		Camden		Charlton		Chatham	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bluefish							50,000	$5,000
Catfish and bullheads	800	$40					60	15
Flounders							12,690	900
Groupers							8,274	414
Hickory shad	200	30					11,427	1,000
Jewfish							3,200	160
King whiting or "kingfish"							52,500	2,100
Menhaden			30,030,000	$113,310				
Mullet	2,500	175					36,445	2,550
Muttonfish							1,650	132
Sea bass							85,200	8,380
Shad	58,200	12,700	36,000	7,457	9,000	$1,864	143,980	38,000
Snapper, red							22,500	1,920
Squeteagues or "sea trout"							2,000	300
Striped bass	250	45					150	12
Crabs, hard							414,341	16,316
Shrimp			715,000	42,900			669,800	35,632
Clams, hard, public							800	125
Oysters, market, public							109,760	4,276
Oysters, market, private							483,700	20,509
Terrapin							13,051	4,000
Total	61,950	12,990	30,781,000	163,667	9,000	1,864	2,121,528	141,741

Fisheries of Georgia, 1928—Continued

CATCH: BY COUNTIES—Continued

Species	Glynn		Liberty		McIntosh		Tattnall		Wayne	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Catfish and bullheads					140,000	$14,000				
Croakers	10,300	$1,030								
Drum, black	3,250	170								
Drum, red, or redfish	6,000	375								
Flounders	3,000	363								
Hickory shad	26,250	3,500			8,250	825	4,800	$445	2,625	$245
King whiting or "kingfish"	3,500	350								
Mullet	16,500	1,300			1,880	150				
Shad	39,900	7,180			12,687	2,475	11,700	2,650	5,800	1,350
Sheepshead, salt-water	1,470	200								
Spot	7,900	640								
Squeteagues or "sea trout"	15,700	2,217			416	50				
Striped bass	340	50								
Sturgeon					1,750	350				
Tripletail	1,550	212								
Crabs, hard	155,000	3,100								
Shrimp	7,143,394	406,952			997,850	59,870				
Oysters, market, public	89,880	8,700								
Oysters, market, private	7,000	500	82,810	$4,750	275,275	15,935				
Terrapin	16,650	5,291			1,875	800				
Total	7,547,584	442,130	82,810	4,750	1,439,983	94,455	16,500	3,095	8,425	1,[illegible]95

INDUSTRIES RELATED TO THE FISHERIES

Transporting trade.—In 1928 there were 44 persons in Georgia engaged in transporting the catch of fish. In this trade 18 motor vessels and 3 sailing vessels, having a combined capacity of 246 net tons, were operated. The size of vessel in most popular use ranged from 5 to 10 net tons.

Wholesale trade.—There were 24 wholesale establishments in Georgia engaged chiefly in handling fresh and frozen products. This is 11 per cent of the total number of such establishments in the South Atlantic section. These establishments employed 395 persons who received $148,858 in salaries and wages. Glynn County accounted for 10 of these establishments and 9 were located in Chatham County.

Prepared and by-products trade.—There were 13 establishments in 1928 engaged primarily in the manufacture of prepared-products or by-products. This is 22 per cent of the total number in the South Atlantic section. They employed 497 persons who received $172,338 in salaries and wages. The products manufactured, consisting principally of canned shrimp and oysters, were valued at $886,049. Detailed statistics of most of the items manufactured may be obtained from Fishery Industries of the United States, 1928, Bureau of Fisheries Document No. 1067.

Industries related to the fisheries of Georgia, 1928

TRANSPORTING

Items	Number
Men on transporting vessels	44
Transporting vessels:	
Motor—	
5 to 10 tons	11
11 to 20 tons	6
41 to 50 tons	1
Total	18
Net tonnage	223
Sail, 5 to 10 tons	3
Net tonnage	23
Total vessels	21
Total net tonnage	246

WHOLESALE FISHERY TRADE

Items	Chatham County	Glynn County	Liberty and McIntosh Counties	Total
Establishments	9	10	5	24
Persons engaged:				
Proprietors	11	13	7	31
Salaried employees	28	19	1	48
Wage earners	52	234	30	316
Paid to salaried employees	$38,710	$16,898	$300	$55,908
Paid to wage earners	23,700	63,550	5,700	92,950
Total salaries and wages	62,410	80,448	6,000	148,858

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS

Items	Number	Products	Quantity	Value
Establishments	13	Canned:		
Persons engaged:		Oysters—standard cases [1]	22,100	$119,730
Proprietors	21	Shrimp—		
Salaried employees	51	Dry pack do	30,074	184,671
Wage earners	425	Wet pack do	67,492	394,603
		Miscellaneous products [2]		187,045
Paid to salaried employees	$58,837			
Paid to wage earners	113,501	Total		886,049
Total salaries and wages	172,338			

[1] A standard case contains forty-eight 5-ounce cans of oysters, forty-eight 5-ounce cans in the dry pack, or forty-eight 5¾-ounce cans in the wet pack of shrimp.
[2] Includes canned clam chowder, canned terrapin meat and terrapin soup, and acidulated scrap and oil from menhaden.

EAST COAST OF FLORIDA [5]

The fisheries of the east coast of Florida in 1928 employed 25 per cent of the total number of fishermen and accounted for 26 per cent of the total catch of the South Atlantic section. The fisheries and industries related to the fisheries employed 3,806 persons, which is a decrease of less than one-half of 1 per cent as compared with the number employed in 1927. Of the total, 3,026 were fishermen, 1 was employed on a transporting vessel, 582 in the wholesale trade, and 197 in the prepared-products and by-products industries.

[5] See pp. 914-923 for complete statistics for Florida.

The total catch amounted to 67,040,079 pounds, valued at $2,214,839. This is an increase of 11 per cent in the catch and 18 per cent in the value of the catch as compared with the catch and its value for 1927. Of the total value of the catch, that for shrimp accounted for 39 per cent; mullet, 11 per cent; and kingfish, or "king mackerel," Spanish mackerel, and catfish and bullheads each accounted for 6 per cent. Of the total production, that of shrimp accounted for 34 per cent; menhaden, 32 per cent; mullet, 10 per cent; and catfish and bullheads, 5 per cent.

OPERATING UNITS BY GEAR

The catch of fishery products along the east coast of Florida was taken by 3,026 fishermen who used 25 motor vessels, 2,333 motor and other small fishing boats, and 15 major types of gear. The vessels had a combined capacity of 469 net tons. The fisheries accounting for the greatest number of persons were the drift gill-net fishery employing 888 fishermen, the otter-trawl fishery employing 716 fishermen, the troll-line fishery employing 660 fishermen, and the hand-line fishery employing 539 fishermen.

CATCH BY GEAR

Four types of gear accounted for 91 per cent of the fishery products taken in the marine fisheries of the east coast of Florida in 1928. Listed in order of their importance, they were otter trawls which accounted for 34 per cent of the catch; purse seines, 33 per cent; gill nets, 17 per cent; and lines, 7 per cent. The catch by otter trawls was almost exclusively shrimp, that by purse seines almost entirely menhaden, that by gill nets chiefly mullet and Spanish mackerel, and that by hand lines chiefly squeteagues or "sea trout," flounders, muttonfish, and bluefish.

OPERATING UNITS BY COUNTIES

St. Johns and Nassau Counties each accounted for 14 per cent of the total number of fishermen. Dade County followed with 13 per cent. Other counties employing a considerable number of fishermen listed in order of their importance in this respect were Palm Beach, Duval, Putman, Volusia, Martin, Brevard, and St. Lucie—Nassau County accounting for 52 per cent of the total number of fishing vessels. No other county had in excess of four vessels operating in the fishing industries. Dade County led in the number of motor and other small fishing boats, accounting for 13 per cent of the total. Duval followed with 11 per cent.

CATCH BY COUNTIES

Fishing was prosecuted in the marine waters of 15 counties on the east coast of Florida during 1928. Ranked according to value the fisheries of Nassua County were most important, accounting for 50 per cent of the total catch and 22 per cent of the total value of the catch. St. Johns County was next in importance, accounting for 15 per cent of the catch and 18 per cent of the value. Other important counties listed in order of their importance with respect to the value of the catch were Dade, Putman, Martin, and Brevard.

Fisheries of the east coast of Florida, 1928

OPERATING UNITS: BY GEAR

Items	Purse seines		Haul seines, common	Gill nets		Trammel nets	Lines	
	Menhaden	Other		Drift	Set		Hand	Trot with hooks
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	114	30						
On boats and shore—								
Regular			218	860	2	3	290	181
Casual				28			249	
Total	114	30	218	888	2	3	539	181
Vessels:								
Motor—								
5 to 10 tons		1						
11 to 20 tons		1						
31 to 40 tons	1							
41 to 50 tons	1	1						
51 to 60 tons	1							
81 to 90 tons	1							
Total vessels	4	3						
Total net tonnage	221	61						
Boats:								
Motor			74	395	1	2	242	26
Other			158	530	1	1	137	164
Apparatus:								
Number	4	3	78	944	6	3	539	356
Length, yards	1, 200	900	54, 130					
Square yards				1, 507, 500	7, 200	1, 350		
Hooks, baits or snoods							569	58, 600

Items	Lines		Pound nets	Fyke nets	Dip nets	Cast nets	Otter trawls, shrimp
	Trot with baits or snoods	Troll					
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels							46
On boats and shore—							
Regular	4	660	15	3	46	25	670
Total	4	660	15	3	46	25	716
Vessels:							
Motor—							
5 to 10 tons							11
11 to 20 tons							6
21 to 30 tons							1
Total vessels							18
Total net tonnage							187
Boats:							
Motor	2	361	6	2	16		335
Other			8	3	35	6	
Apparatus:							
Number	2	753	21	22	46	19	353
Yards at mouth							6, 673
Hooks, baits or snoods	1, 000	1, 427					

Fisheries of the east coast of Florida, 1928—Continued

OPERATING UNITS: BY GEAR—Continued

Items	Pots		Spears	Tongs	Forks	Sea craw-fish and stone crab hooks	By hand	Total, exclusive of dupli cation
	Eel	Sea craw-fish						
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels								190
On boats and shore—								
Regular	4	55	10	94	62	44	85	2,555
Casual					4			281
Total	4	55	10	94	66	44	85	3,026
Vessels:								
Motor—								
5 to 10 tons								12
11 to 20 tons								7
21 to 30 tons								1
31 to 40 tons								1
41 to 50 tons								2
51 to 60 tons								1
81 to 90 tons								1
Total vessels								25
Total net tonnage								469
Boats:								
Motor	4	32		10	2	18	2	1,202
Other	4	25		62	51	31	73	1,131
Apparatus: Number	65	1,998	10	94	62	44		

CATCH: BY GEAR

Species	Purse seines				Haul seines, common		Gill nets, drift	
	Menhaden		Other					
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Valu*
Alewives					370,128	$2,935		
Black bass					125,200	14,391		
Bluefish			80,000	$6,400	2,476	270	335,404	$38,743
Blue runner or hardtail			20,000	800	1,600	40	91,724	2,957
Butterfish							1,440	43
Catfish and bullheads					2,090,555	85,144	17,092	498
Crappie					350,288	24,539		
Crevalle			15,000	600	38,150	1,141	143,193	4,148
Croaker					3,400	92	40,039	1,342
Drum, black			800	16	34,500	1,091	72,063	1,880
Drum, red, or redfish			1,000	40	15,920	745	130,653	6,181
Eels					545	27		
Flounders					1,020	48	12,672	547
Hickory shad					35,480	1,419		
Jewfish					2,000	40		
King whiting or "kingfish"					3,823	274	111,904	4,804
Ladyfish							3,000	60
Menhaden	21,511,600	$40,330						
Mojarro					188,272	7,387	288,800	14,084
Moonfish							192	5
Mullet			600,000	18,000	140,484	5,409	5,740,526	227,639
Muttonfish			500	50				
Permit					200	4	3,695	116
Pigfish					15,750	470	108,328	3,452
Pinfish or sailors choice					13,600	420	165,401	4,588
Pompano			1,200	240	53,170	13,181	199,219	56,038
Shad					220,912	31,028	465,120	72,678
Sheepshead, salt-water					6,120	258	51,866	2,390
Snapper, mangrove					6,400	256	53,655	2,662
Snook or sergeantfish			1,000	40	10,900	439	156,444	7,504
Spadefish					1,900	54	10,004	327
Spanish mackerel			35,500	2,130			1,982,524	129,005
Spot					17,600	557	210,203	6,571
Squeteagues or "sea trout"					60,000	6,312	857,404	83,498
Sunfish					437,812	17,383		
Crabs, hard							11,340	340
Turtles					6,534	131		
Total	21,511,600	40,330	755,000	28,316	4,254,739	215,485	11,263,905	672,100

Fisheries of the east coast of Florida, 1928—Continued

CATCH: BY GEAR—Continued

Species	Gill nets, set		Trammel nets		Lines			
					Hand		Trot with hooks	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Amberjack					10,347	$470		
Black bass			216	$26	15,200	1,824		
Bluefish					109,045	15,691		
Blue runner or hardtail					3,500	175		
Bonito					2,000	300		
Cabio or crab eater					200	10		
Catfish and bullheads							835,223	$33,798
Crappie			1,000	80				
Crevalle					13,800	480		
Croaker					400	24		
Dolphin					6,000	600		
Drum, black					15,303	513		
Drum, red, or redfish					52,559	2,509		
Flounders					2,300	99		
Groupers					145,466	6,312		
Grunts					38,643	1,531		
Hogfish					3,000	90		
Jewfish					11,900	361		
Kingfish or "king mackerel"					15,000	900		
King whiting or "kingfish"					13,000	1,300		
Mullet			334	16				
Muttonfish					113,400	10,032		
Pike					2,000	100		
Pinfish or sailors choice					300	16		
Pompano					30,300	8,915		
Porgies					22,000	760		
Sea bass					38,169	4,213		
Shad	4,900	$730						
Sheepshead, salt-water					17,758	866		
Snapper, mangrove					29,450	1,952		
Snapper, red					46,450	4,569		
Snook or sergeantfish					80,150	4,142		
Spanish mackerel					23,800	1,918		
Spot					350	17		
Squeteagues or "sea trout"					269,900	27,550		
Sunfish			1,200	60	319	16		
Tripletail					400	16		
Yellowtail					63,300	5,106		
Total	4,900	730	2,750	182	1,195,709	103,377	835,223	33,798

Species	Lines				Pound nets		Fyke nets		Dip nets, common	
	Trot with baits or snoods		Troll							
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Amberjack			1,500	$60						
Barracuda			12,000	360						
Bluefish			72,095	7,350						
Blue runner or hardtail			6,500	205						
Catfish and bullheads					255,221	$10,961	5,000	$200		
Cero			5,000	250						
Crappie					34,000	2,380	2,169	213		
Crevalle			3,593	114						
Groupers			1,500	90						
Kingfish or "king mackerel"			2,630,656	135,817						
Muttonfish			1,000	100						
Snapper, red			600	60						
Snook or sergeantfish			2,500	140						
Spanish mackerel			32,558	2,856						
Sunfish					16,000	640	900	45		
Yellowtail			1,134	68						
Crabs, hard	83,000	$3,000							39,936	$3,994
Sea crawfish or spiny lobster									87,963	7,037
Total	83,000	3,000	2,770,636	147,470	305,221	13,981	8,069	458	127,899	11,031

Fisheries of the east coast of Florida, 1928—Continued

CATCH: BY GEAR—Continued

Species	Cast nets		Otter trawls, shrimp		Pots: Eel		Pots: Sea crawfish		Spears	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Drum, black			2,784	$56						
Drum, red, or redfish	1,892	$151								
Eels					15,468	$619				
Flounders			27,565	699					3,000	$180
King whiting or "kingfish"			247,763	7,764						
Mullet	45,450	3,624								
Squeteagues or "sea trout"			51,190	1,520						
Crabs, stone							32,000	$3,520		
Sea crawfish or spiny lobster							235,026	18,802		
Shrimp			22,507,186	864,614						
Total	47,342	3,775	22,836,488	874,653	15,468	619	267,026	22,322	3,000	180

Species	Tongs		Forks		Sea crawfish and stone crab hooks		By hand	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Crabs, stone					3,000	$330		
Sea crawfish or spiny lobster					44,117	3,529		
Clams, hard, public			25,840	$3,092				
Oysters, market, public	195,034	$17,276					382,753	$12,865
Oysters, market, private	87,360	5,340					14,000	600
Total	282,394	22,616	25,840	3,092	47,117	3,859	396,753	13,465

OPERATING UNITS: BY COUNTIES

Items	Brevard	Broward	Clay	Dade	Duval	Flagler	Indian River	Martin
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels				30				3
On boats and shore—								
Regular	158	50	35	306	269	3	63	136
Casual	18	25		70	12		4	40
Total	176	75	35	406	281	3	67	179
Vessels:								
Motors—								
5 to 10 tons				1				
11 to 20 tons				1				
21 to 30 tons								1
41 to 50 tons				1				
Total				3				1
Net tonnage				61				21
Boats:								
Motor	63	28	11	202	91		39	123
Other	163	12	26	106	168	1	52	63
Apparatus:								
Purse seines—								
Other than menhaden				3				
Yards				900				
Haul seines, common			7		6	1		6
Yards			6,800		1,400	350		6,000
Gill nets—								
Drift	189	7		82	154		58	95
Square yards	153,350	6,800		144,900	246,800		46,250	148,100
Set					6			
Square yards					7,200			
Lines—								
Hand	30	43		220	52	3	14	38
Hooks	30	43		220	71	3	14	38
Trot			35		242			
Hooks			11,500		12,100			
Troll	24	24		194	27		28	110
Hooks	24	48		388	27		28	220

Fisheries of the east coast of Florida, 1928—Continued

OPERATING UNITS: BY COUNTIES—Continued

Items	Brevard	Broward	Clay	Dade	Duval	Flagler	Indian River	Martin
Apparatus—Continued.	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Dip nets				42	4			
Cast nets		12				1		
Otter trawls, shrimp					10			1
Yards at mouth					200			30
Pots, sea crawfish		220		1,778				
Tongs					24		4	
Hooks				44				

Items	Nassau	Palm Beach	Putnam	St. Johns	St. Lucie	Seminole	Volusia
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	138			9			10
On boats and shore—							
Regular	270	260	212	427	159	63	144
Casual	20	28	20				44
Total	428	288	232	436	159	63	198
Vessels:							
Motor—							
5 to 10 tons	6			3			2
11 to 20 tons	3			1			2
31 to 40 tons	1						
41 to 50 tons	1						
51 to 60 tons	1						
81 to 90 tons	1						
Total	13			4			4
Net tonnage	313			33			41
Boats:							
Motor	119	125	75	201	86		39
Other	53	38	170	21	64	63	131
Apparatus:							
Purse seines—							
Menhaden	4						
Yards	1,200						
Haul seines, common			48	2			8
Yards			33,400	150			6,030
Gill nets—							
Drift	20	104	25		156		54
Square yards	7,200	157,000	53,500		498,200		45,400
Trammel nets			3				
Square yards			1,350				
Lines—							
Hand		49	20		13		57
Hooks		49	20		13		68
Trot			16			63	
Hooks			4,000			31,000	
Trot with baits or snoods							2
Baits or snoods							1,000
Troll		222			124		
Hooks		444			248		
Pound nets			21				
Fyke nets			22				
Cast nets				6			
Otter trawls, shrimp	127			205			10
Yards at mouth	2,422			3,792			229
Pots, eel			65				
Spears							10
Tongs					8		58
Forks				16			46

Fisheries of the east coast of Florida, 1928—Continued

CATCH: BY COUNTIES

Species	Brevard		Broward		Clay		Dade	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Amberjack			5,000	$270			5,500	$220
Barracuda							12,000	360
Black bass					19,075	$1,938		
Bluefish	4,295	$430	9,200	920			109,400	9,340
Blue runner or hardtail	2,400	48	13,500	475			30,500	1,115
Catfish and bullheads	7,759	155			617,089	24,844		
Cero							5,000	250
Crappie					2,996	239		
Crevalle	27,938	631	6,800	260			30,000	1,050
Croaker	7,218	162						
Dolphin			6,000	600				
Drum, black	32,988	670	600	18			10,800	316
Drum, red, or redfish	74,768	2,975	1,000	40			8,500	340
Flounders	4,117	146						
Groupers			33,500	2,010			88,000	3,520
Grunts							37,200	1,488
Hogfish							3,000	90
Jewfish							11,500	345
Kingfish or "king mackerel"	3,358	201	158,000	10,910			617,000	30,85
King whiting or "kingfish"	55,389	2,106					2,000	80
Ladyfish							3,000	60
Mojarro	50,056	1,502	3,400	136			5,000	150
Mullet	2,219,215	80,864	50,400	3,712			1,468,000	52,720
Muttonfish			47,000	4,700			61,900	4,962
Permit							2,000	60
Pigfish	56,698	1,602					2,000	60
Pinfish or sailors choice	116,381	3,120					500	15
Pompano	23,153	5,778	200	40			4,200	840
Porgies			5,000	250			17,000	510
Sheepshead, salt-water	16,276	596					1,000	40
Snapper, mangrove	8,923	321	1,400	84			21,350	1,708
Snapper, red			4,100	410			15,800	1,264
Snook or sergeantfish	41,311	1,580	2,200	128			6,000	240
Spadefish	2,869	77	200	6				
Spanish mackerel			23,000	1,840			539,100	32,346
Spot	82,690	2,232					1,000	30
Squeteagues or "sea trout"	529,019	50,032					22,000	1,760
Sunfish					69,171	2,075		
Yellowtail			2,100	210			61,200	4,896
Crabs, hard	11,340	340						
Crabs, stone							35,000	3,850
Sea crawfish or spiny lobster			34,000	2,720			333,106	26,648
Total	3,378,161	155,568	406,600	29,739	708,331	29,096	3,569,556	181,523

Species	Duval		Flagler		Indian River		Martin	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bluefish	845	$67	200	$20	9,380	$1,042	108,981	$16,250
Blue runner or hardtail					2,700	81	21,672	837
Butterfish					1,440	43		
Catfish and bullheads	417,000	16,780					24,133	691
Crevalle	3,898	100			18,230	477	56,730	1,829
Croaker	5,100	239			6,360	191	16,510	606
Drum, black	7,600	256	700	35	8,615	224	36,960	1,098
Drum, red, or redfish	13,348	677	5,000	250	18,719	748	29,866	1,584
Flounders	2,000	104	300	15	5,600	224	2,275	118
Groupers	114	11			5,000	150	4,000	200
Jewfish							2,400	56
Kingfish or "king mackerel"					828	41	57,607	4,032
King whiting or "kingfish"	1,000	50	3,000	300	17,435	697	12,832	748
Mojarro					35,016	1,258	263,386	12,072
Mullet	307,855	15,893	2,400	120	643,626	25,745	703,965	27,618
Muttonfish							2,000	200
Permit							720	25
Pigfish					12,600	378	20,880	643
Pinfish or sailors choice	1,220	43	250	13	13,410	342	15,040	462
Pompano	828	207	200	60	26,250	6,030	163,893	46,042
Seabass	16,969	1,697			400	20		
Shad	224,243	33,240						
Sheepshead, salt-water	4,658	243	500	25	12,300	492	20,025	1,073
Snapper, mangrove					15,920	637	15,196	752
Snapper, red	9,532	953			4,518	452		
Snook or sergeantfish	100	3	100	5	37,164	1,486	99,943	5,736
Spadefish					700	21	4,529	153
Spanish mackerel	14,046	1,646			9,912	694	346,303	27,704
Spot	15,458	635	400	20	63,973	1,721	36,282	1,267
Squeteagues or "sea trout"	78,189	8,973	2,400	360	197,012	19,701	82,514	8,251
Tripletail					400	16		
Crabs, hard	39,936	3,994						
Shrimp	298,951	11,958					168,750	6,000
Oysters, market, public	64,330	7,765			12,474	1,782		
Total	1,527,220	105,434	15,450	1,223	1,179,982	64,693	2,317,392	166,047

Fisheries of the east coast of Florida, 1928—Continued

CATCH: BY COUNTIES—Continued

Species	Nassau		Palm Beach		Putnam		St. Johns	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives					311,021	$2,344		
Amberjack			1,347	$40				
Black bass					107,697	12,919		
Bluefish			237,478	24,028			320	$38
Blue runner or hardtail			32,952	1,001				
Catfish and bullheads					1,559,348	65,141		
Crappie					354,367	25,168		
Crevalle			21,993	670			200	16
Croaker			3,051	92				
Drum, black	800	$16	3,603	113			3,384	152
Drum, red, or redfish			5,631	311			2,692	231
Eels					16,013	646		
Flounders	17,647	402					10,018	305
Groupers			14,352	431				
Grunts			1,443	43				
Hickory shad					34,440	1,377		
Kingfish or "king mackerel"			1,402,816	70,381				
King whiting or "kingfish"	108,911	3,598	7,871	355			139,752	4,238
Menhaden	21,511,600	40,330						
Mojarro			90,214	5,153				
Moonfish			192	5				
Mullet			37,896	1,366	4,734	236	5,650	452
Muttonfish			4,000	320				
Permit			175	5				
Pigfish			3,000	90				
Pike					2,000	100		
Pinfish or sailors choice			1,850	56				
Pompano			42,681	12,504			40	10
Shad	31,932	6,215			402,604	59,311		
Sheepshead, salt-water			3,685	187			100	8
Snapper, mangrove			5,516	288				
Snapper, red			1,100	110				
Snook or sergeantfish			22,376	995				
Spadefish			1,576	49				
Spanish mackerel			156,989	12,559				
Spot			1,100	34			600	30
Squeteagues or "sea trout"	1,600	32	3,607	308			50,190	1,560
Sunfish					329,229	13,756		
Yellowtail			1,134	68				
Shrimp	11,590,120	426,647					9,673,115	392,409
Clams, hard, public							9,040	840
Oysters, market, public	290,913	6,084					50,190	1,770
Oysters, market, private	14,000	600						
Turtles					6,534	131		
Total	33,567,523	483,924	2,109,628	131,562	3,127,987	181,129	9,945,291	402,059

Species	St. Lucie		Seminole		Volusia	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives					59,107	$591
Black bass					13,844	1,384
Bluefish	47,341	$5,681			71,580	10,638
Blue runner or hardtail	10,000	300			9,600	320
Bonito					2,000	300
Cabio or crab eater					200	10
Catfish and bullheads	2,000	60	367,500	$14,700	208,262	8,330
Crappie					30,094	1,805
Crevalle	34,547	1,036			13,400	414
Croaker	3,000	90			2,600	78
Drum, black	8,000	240			11,400	418
Drum, red, or redfish	6,000	300			36,500	2,170
Flounders	500	25			4,100	234
Groupers					2,000	80
Hickory shad					1,040	42
Kingfish or "king mackerel"	406,047	20,302				
King whiting or "kingfish"	15,000	750			13,300	1,220
Mojarro	30,000	1,200				
Mullet	609,053	24,362			474,000	21,600
Permit	1,000	30				
Pigfish	10,000	300			18,900	849
Pinfish or sailors choice	2,000	60			28,650	913
Pompano	19,244	5,773			3,200	1,090
Seabass					20,800	2,496
Shad					32,153	5,670
Sheepshead, salt-water	10,000	500			7,200	350
Snapper, mangrove	20,000	1,000			1,200	80
Snapper, red					12,000	1,440
Snook or sergeantfish	40,000	2,000			1,800	92

Fisheries of the east coast of Florida, 1928—Continued

CATCH: BY COUNTIES—Continued

Species	St. Lucie		Seminole		Volusia	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Spadefish	1,000	$30			1,030	$45
Spanish mackerel	984,832	59,090			200	30
Spot	5,000	150			21,650	1,026
Squeteagues or "sea trout"	94,163	7,573			177,800	20,330
Sunfish					57,831	2,313
Crabs, hard					83,000	3,000
Shrimp					776,250	27,600
Clams, hard, public					16,800	2,252
Oysters, market, public	26,880	3,840			133,000	8,900
Oysters, market, private					87,360	5,340
Total	2,385,607	134,692	367,500	$14,700	2,433,851	133,450

INDUSTRIES RELATED TO THE FISHERIES

Transporting trade.—In 1928 there was only one person on the east coast of Florida engaged primarily in transporting the catch of fish. One motor vessel having a capacity of 16 net tons was operated in this trade.

Wholesale trade.—There were 101 wholesale establishments along the east coast of Florida engaged chiefly in handling fresh and frozen fishery products. This is 44 per cent of the total number of such establishments in the South Atlantic section. These establishments employed 582 persons who received $360,562 in salaries and wages. Duval County accounted for 16 per cent of these establishments; St. Johns, 15 per cent; and Nassau, 12 per cent.

Prepared and by-products trade.—There were eight establishments along the east coast of Florida engaged primarily in the manufacture of prepared fishery products or by-products. This is 13 per cent of the total number in the South Atlantic section. They employed 197 persons who received $184,547 in salaries and wages. The products manufactured consisting principally of menhaden products and canned shrimp, were valued at $1,038,089. Detailed statistics of most of the items manufactured may be obtained from Fishery Industries of the United States, 1928, Bureau of Fisheries Document 1067.

Industries related to the fisheries of the east coast of Florida, 1928

TRANSPORTING

Items	Number
Men on transporting vessels	1
Transporting vessels (motor)	1
Net tonnage	16

WHOLESALE FISHERY TRADE

Items	Brevard	Dade	Duval	Indian River	Martin	Nassau
Establishments	10	7	16	5	5	12
Persons engaged:						
Proprietors	12	11	15	8	5	13
Salaried employees	1	5	18		5	2
Wage earners	14	14	46	6	5	93
Paid to salaried employees	$1,500	$15,520	$57,796		$9,600	$1,760
Paid to wage earners	8,782	15,656	33,332	$4,665	3,470	44,313
Total salaries and wages	10,282	31,176	91,128	4,665	13,070	46,073

Industries related to the fisheries of the east coast of Florida, 1928—Continued

WHOLESALE FISHERY TRADE—Continued

Items	Palm Beach	Putnam and Clay	St. Johns	St. Lucie	Volusia	Total
Establishments	7	11	15	7	6	101
Persons engaged:						
Proprietors	9	11	16	7	6	113
Salaried employees	9	2	6	6	2	56
Wage earners	9	29	150	18	29	413
Paid to salaried employees	$16,980	$3,947	$7,736	$9,540	$2,000	$126,379
Paid to wage earners	7,530	19,908	71,454	10,765	14,308	234,183
Total salaries and wages	24,510	23,855	79,190	20,305	16,308	360,562

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS

Items	Number	Product	Quantity	Value
Establishments	8	Canned shrimp:		
Persons engaged:		Dry pack...standard cases [1]	3,766	$22,003
Proprietors	9	Wet pack...do	44,319	349,213
Salaried employees	20	Miscellaneous products [2]		666,873
Wage earners	168			
Paid to salaried employees	$72,445	Total		1,038,089
Paid to wage earners	112,102			
Total salaries and wages	184,547			

[1] A standard case contains forty-eight 5-ounce cans in the dry pack or forty-eight 5¾-ounce cans in the wet pack.
[2] Includes oyster-shell products, canned oysters, pickled shrimp, and fish meal, acid scrap, dry scrap, and oil from menhaden.

HISTORICAL REVIEW

Twelve general surveys have been made for statistics of the fisheries of the South Atlantic States during the 49 years from 1880 to 1928. Beginning with a catch of 42,952,000 pounds in 1880 it constantly increased until 1918 when the greatest catch on record was taken which amounted to 332,614,000 pounds. This large catch was due principally to the large catch of menhaden taken that year. In 1928 the catch amounted to 258,440,000 pounds. Comparative statistics for the catch of each of the more important species throughout this period are shown in the following tables.

Fisheries of the South Atlantic States, 1880 to 1928

[Expressed in thousands of pounds and thousands of dollars; that is, 000 omitted]

Year	North Carolina		South Carolina		Georgia		Florida (east coast)		Total	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
1880	32,249	846	6,143	212	2,273	120	2,287	78	42,952	1,256
1887	45,125	773	4,076	158	1,883	81	(1)	(1)	(1)	(1)
1888	43,023	776	4,181	164	1,958	83	(1)	174	(1)	1,197
1889	45,546	950	4,879	200	2,644	106	5,982	199	59,051	1,455
1890	51,799	1,028	4,915	203	2,994	124	7,464	220	67,202	1,575
1897	64,234	1,316	5,280	210	4,993	171	5,883	136	80,390	1,833
1902	67,585	1,740	8,174	263	11,103	359	19,584	478	106,446	2,840
1908	101,422	1,776	14,104	288	14,828	701	36,521	1,269	166,875	4,034
1918	210,502	2,979	3,747	208	37,154	416	81,211	1,746	332,614	5,349
1923	95,192	2,414	6,763	285	39,896	668	86,896	1,720	228,747	5,087
1927	144,466	2,777	8,374	350	47,607	697	60,222	1,871	260,669	5,695
1928	141,899	2,629	7,432	317	42,069	866	67,040	2,215	258,440	6,027

[1] Figures not available.

Fisheries of the South Atlantic States, 1880 to 1928—Continued

CATCH OF CERTAIN SPECIES: BY STATES

[Expressed in thousands of pounds; that is, 000 omitted]

Year	Alewives					Bluefish				
	North Carolina	South Carolina	Georgia	Florida (east coast)	Total	North Carolina	South Carolina	Georgia	Florida (east coast)	Total
1880	15,520	400	125	10	16,055	600	200	5	25	830
1887	23,747	-----	25	-----	-----	761	158	7	(1)	-----
1888	20,451	-----	24	-----	-----	847	151	6	(1)	-----
1889	19,316	37	36	-----	19,389	1,078	110	-----	5	1,193
1890	22,112	29	24	10	22,175	1,539	100	-----	7	1,646
1897	20,839	2	25	41	20,907	1,910	40	-----	46	1,996
1902	15,173	-----	22	406	15,601	1,049	1	-----	80	1,130
1908	12,530	-----	32	1,220	13,782	1,258	7	-----	372	1,637
1918	17,356	10	-----	692	18,058	323	3	5	561	892
1923	8,989	-----	-----	1,062	10,051	897	7	-----	1,101	2,005
1927	13,911	-----	-----	213	14,124	852	13	-----	772	1,637
1928	7,808	2	-----	370	8,180	754	4	50	599	1,407

Year	Butterfish [2]		Croaker					Drum, black				
	North Carolina	Florida (east coast)	North Carolina	South Carolina	Georgia	Florida (east coast)	Total	North Carolina	South Carolina	Georgia	Florida (east coast)	Total
1887	-----	-----	(1)	(1)	(1)	(1)	-----	-----	90	10	(1)	-----
1888	-----	-----	(1)	(1)	(1)	(1)	-----	-----	75	11	(1)	-----
1889	-----	-----	328	(1)	(1)	(1)	-----	-----	170	17	41	228
1890	-----	-----	354	(1)	(1)	(1)	-----	-----	185	15	28	228
1897	95	-----	1,295	(1)	(1)	(1)	-----	51	215	14	17	297
1902	83	-----	1,939	27	29	7	2,002	67	75	25	20	187
1908	1,302	-----	1,177	85	46	92	1,400	-----	-----	-----	-----	-----
1918	731	-----	387	16	6	124	533	-----	5	-----	531	536
1923	820	-----	2,262	26	-----	22	2,310	2	13	-----	47	62
1927	1,280	-----	3,932	13	3	39	3,987	11	3	-----	84	98
1928	112	1	6,775	12	10	44	6,841	9	4	3	125	141

Year	Drum, red, or redfish					Eels			
	North Carolina	South Carolina	Georgia	Florida (east coast)	Total	North Carolina	Georgia	Florida (east coast)	Total
1887	129	55	20	(1)	-----	6	-----	-----	-----
1888	140	51	21	(1)	-----	7	-----	-----	-----
1889	515	91	32	172	810	55	-----	-----	55
1890	219	88	39	171	517	161	-----	-----	161
1897	179	110	24	236	549	97	5	-----	102
1902	144	102	35	115	396	507	5	-----	512
1908	[3] 343	109	151	818	1,421	258	6	-----	264
1918	[3] 100	1	2	369	472	175	-----	-----	175
1923	245	31	1	122	399	180	-----	-----	180
1927	99	7	1	163	270	160	-----	-----	160
1928	237	5	6	202	450	77	-----	16	93

Year	Flounders					Menhaden			
	North Carolina	South Carolina	Georgia	Florida (east coast)	Total	North Carolina	Georgia	Florida (east coast)	Total
1887	-----	-----	-----	(1)	-----	14,756	-----	-----	-----
1888	-----	-----	-----	(1)	-----	13,844	-----	-----	-----
1889	48	-----	-----	-----	48	8,753	-----	8	8,761
1890	49	-----	-----	-----	49	12,410	-----	-----	12,410
1897	174	-----	6	-----	180	11,310	-----	-----	11,310
1902	262	2	3	49	316	18,862	-----	-----	18,862
1908	403	5	7	99	514	57,412	-----	-----	57,412
1918	91	16	11	13	131	179,911	29,485	48,363	257,759
1923	333	28	-----	6	367	63,290	26,973	57,918	148,181
1927	349	14	-----	21	384	98,987	34,102	24,876	157,965
1928	455	21	16	47	539	99,302	30,030	21,512	150,844

[1] Statistics not available. [2] Includes harvestfish. [3] Includes some black drum.

NOTE.—Prior to 1889 some of the above species were often included under the heading "Miscellaneous fish" or "All other fish"; therefore, the total for certain species is not shown for certain years of this period.

Fisheries of the South Atlantic States, 1880 to 1928—Continued

CATCH OF CERTAIN SPECIES: BY STATES—Continued

[Expressed in thousands of pounds; that is, 000 omitted]

Year	Mullet					Pompano			
	North Carolina	South Carolina	Georgia	Florida (east coast)	Total	North Carolina	South Carolina	Florida (east coast)	Total
1880	3,368	232	106	663	4,369				
1887	2,461	400	47	(1)				(1)	
1888	2,248	341	48	(1)				(1)	
1889	4,252	464	57	1,216	5,989	8		12	20
1890	4,890	553	53	1,567	7,063	10		30	40
1897	4,716	61	56	2,449	7,282	53	5	196	254
1902	8,429	139	126	7,341	16,035	20	5	265	290
1908	6,013	708	194	8,573	15,488	11	4	276	291
1918	1,286	272	11	10,418	11,987	9		133	142
1923	1,933	532	4	6,198	8,667	50		61	111
1927	4,325	461	9	6,583	11,378	13	6	219	238
1928	2,502	291	57	6,527	9,377	8		284	292

Year	Sea bass					Shad				
	North Carolina	South Carolina	Georgia	Florida (east coast)	Total	North Carolina	South Carolina	Georgia	Florida (east coast)	Total
1880						3,221	208	252	252	3,933
1887	15	889	4	(1)		4,783	366	255	(1)	
1888	15	910	7	(1)		5,725	433	263	1,448	7,869
1889	29	886	8	11	934	5,403	577	356	2,051	8,387
1890	33	826	10	10	879	5,815	563	400	2,654	9,432
1897	189	632		6	827	8,963	506	788	1,011	11,268
1902	57	710	76	30	873	6,567	434	1,029	1,819	9,849
1908	72	491	233	110	906	3,942	464	1,333	2,833	8,572
1918	112	132	293	41	578	1,657	167	101	964	2,889
1923	102	218	104	4	428	2,370	184	134	503	3,191
1927	316	125	48	32	521	2,387	182	187	348	3,104
1928	424	271	85	38	818	3,118	320	317	691	4,446

Year	Sheepshead					Spanish mackerel				
	North Carolina	South Carolina	Georgia	Florida (east coast)	Total	North Carolina	South Carolina	Georgia	Florida (east coast)	Total
1887	202	101	8	(1)					(1)	
1888	212	111	8	(1)					(1)	
1889	187	39	5	264	495	82				82
1890	202	39	5	274	520	100				100
1897	271	36	25	390	722	331	10	18	3	362
1902	155	27	50	404	636	354			659	1,013
1908	249	20	64	1,098	1,431	457			1,228	1,685
1918	26	2		104	132	149			3,062	3,211
1923	52	1		32	85	183			2,469	2,652
1927	23			54	77	200			1,921	2,121
1928	22		1	76	99	176			2,074	2,250

[1] Statistics not available.

NOTE.—Prior to 1889 some of the above species were often included under the heading "Miscellaneous fish" or "All other fish"; therefore, the total for certain species is not shown for certain years of this period.

Fisheries of the South Atlantic States, 1880 to 1928—Continued

CATCH OF CERTAIN SPECIES: BY STATES—Continued

[Expressed in thousands of pounds; that is, 000 omitted]

Year	Spot					Squeteagues or "sea trout"				
	North Carolina	South Carolina	Georgia	Florida (east coast)	Total	North Carolina	South Carolina	Georgia	Florida (east coast)	Total
1880						1,120	470	122	115	1,827
1887	[4] 88	[4] 52	[4] 11	(1)		909	217	67	(1)	
1888	[4] 90	[4] 57	[4] 10	(1)		946	207	67	(1)	
1889	441	[4] 46	[4] 14	[4] 26		1,971	116	130	243	2,460
1890	499	[4] 42	[4] 14	[4] 24		2,131	103	144	235	2,613
1897	917	[4] 49		[4] 23		3,174	80	55	516	3,825
1902	977	22		32	1,031	3,984	86	83	899	5,052
1908	852	66		130	1,048	4,648	183	140	3,657	8,628
1918	1,258	75	1	393	1,727	3,361	59	40	1,645	5,105
1923	1,790	132	1	72	1,995	3,984	70	5	1,198	5,257
1927	1,959	216	1	421	2,597	4,534	54	18	869	5,475
1928	2,954	90	8	228	3,280	5,127	20	18	1,238	6,403

Year	Striped bass					Sturgeon				
	North Carolina	South Carolina	Georgia	Florida (east coast)	Total	North Carolina	South Carolina	Georgia	Florida (east coast)	Total
1880						437	261	354	3	1,055
1887	506	4	11			238	182	192	(1)	
1888	567	3	11			270	251	174	(1)	
1889	536	11	13		560	228	[5] 285	[5] 212	43	768
1890	574	12	9		595	175	[5] 216	[5] 84	30	505
1897	845	10	9		864	[5] 404	[5] 481	[5] 157		1,042
1902	1,175	10	2		1,187	145	94			239
1908	510	5	9	9	533	62		100	55	217
1918	287				287	8	118	39		165
1923	477				477	19	50	32		101
1927	738		5	2	745	27	13	3		43
1928	507		1		508	8	23	2		33

Year	Crabs					Shrimp				
	North Carolina	South Carolina	Georgia	Florida (east coast)	Total	North Carolina	South Carolina	Georgia	Florida (east coast)	Total
1880	11	42	7			63	630	56	72	821
1887	47	76	45	(1)		120	338	185	(1)	
1888	47	69	44	(1)		124	359	191	(1)	
1889	50	86	43	3	182	135	380	150	78	743
1890	47	93	48	4	192	144	372	162	66	744
1897	1,027	110	75	4	1,216	146	374	68	39	627
1902	203	96	80	6	385	84	370	344	3,013	3,811
1908	390	33	196	146	765	371	452	528	4,346	5,697
1918	379	18	8	52	457	940	55	5,793	8,868	15,656
1923	514	9	120	72	715	1,658	355	10,668	11,024	23,705
1927	1,225	10	59	128	1,422	1,276	1,657	12,280	14,779	29,992
1928	1,476	2	569	169	2,216	845	431	9,526	22,507	33,309

[1] Statistics not available. [4] Includes croakers. [5] Includes caviar.

NOTE.—Prior to 1889 some of the above species were often included under the heading "Miscellaneous fish" or "All other fish"; therefore, the total for certain species is not shown for certain years of this period.

Fisheries of the South Atlantic States, 1880 to 1928—Continued

CATCH OF CERTAIN SPECIES: BY STATES—Continued

[Expressed in thousands of pounds; that is, 000 omitted]

Year	Clams, hard					Oysters, market					Scallops, North Carolina
	North Carolina	South Carolina	Georgia	Florida (east coast)	Total	North Carolina	South Carolina	Georgia	Florida (east coast)	Total	
1880	310	48	24	5	387	1,190	350	490	140	2,170	--------
1887	78	--------	--------	(1)	--------	1,491	264	771	(1)	--------	4
1888	148	--------	--------	(1)	--------	1,433	282	844	(1)	--------	4
1889	155	--------	3	5	163	7,011	305	1,142	436	8,894	16
1890	226	--------	4	6	236	5,651	442	1,570	681	8,344	18
1897	938	185	3	5	1,131	6,012	1,504	3,406	363	11,285	118
1902	1,175	225	10	5	1,415	7,160	4,828	8,568	2,163	22,719	13
1908	726	76	43	57	902	5,275	10,941	10,053	3,704	29,973	(1)
1918	198	1	--------	2	201	1,519	2,784	1,110	459	5,872	423
1923	264	86	--------	5	355	3,917	5,032	1,720	500	11,169	555
1927	315	47	1	10	373	3,041	5,440	757	782	10,020	835
1928	324	26	1	26	377	2,900	5,798	1,048	679	10,425	1,394

[1] Statistics not available.

NOTE.—Prior to 1889 some of the above species were often included undert he heading "Miscellaneous fish" or "All other fish"; therefore, the total for certain species is not shown for certain years of this period.

FISHERIES OF FLORIDA [6]

Commercial fisheries are prosecuted along the entire length of the Florida seacoast from Fernandina south to Key West and from there north and west to Pensacola, and also in Lake Okeechobee. The fisheries and industries related to the fisheries of Florida employed 10,852 persons during 1928. This is an increase of 6 per cent over the number employed during 1927. Of the total, 9,098 were fishermen, 48 were employed aboard transporting vessels, 1,277 in the wholesale trade, and 429 in the prepared-products and by-products industries. The catch amounted to 131,838,020 pounds, valued at $6,250,360. This represents a decrease of 5 per cent in the catch and 3 per cent in the value of the catch as compared with the catch and the value of the catch for 1927. Of the total catch, 100,700,203 pounds, valued at $4,034,552, were fish; 30,583,459 pounds, valued at $1,364,446, were shellfish and miscellaneous products; and 554,358 pounds, valued at $851,362, were sponges. Of the total, 51 per cent were taken along the east coast, 46 per cent along the west coast, and 3 per cent in Lake Okeechobee.

OPERATING UNITS

The catch of fishery products during 1928 was made by 9,098 fishermen, who used 108 motor vessels and 13 sailing vessels with a combined capacity of 3,915 net tons; 3,248 motor boats; and 4,243 other small boats. The fishing gear consisted of 6 menhaden purse seines, having a combined length of 1,760 yards; 3 other purse seines, having a combined length of 900 yards; 276 common haul seines having a combined length of 148,745 yards; 2,797 drift gill nets, having a combined area of 3,348,336 square yards; 18 set gill nets, having a

[6] Detailed statistics of the fisheries along the east coast of Florida are discussed separately on pp. 900 to 910 those for the fisheries along the west coast pp. 928 to 941; while those for Lake Okeechobee, as well as those of the Florida sponge fishery, are discussed in this section. Statistics for these districts are combined in this section for the convenience of those readers who are interested in statistics covering the entire State.

combined area of 12,300 square yards; 257 trammel nets having an area of 216,810 square yards; 2,260 hand lines having 3,216 hooks; 1,079 troll lines having 1,905 hooks; 369 trot lines having 62,100 hooks; and 2 trot lines having 1,000 baits or snoods. There were also 31 pound nets; 240 stop nets having a combined area of 39,750 square yards; 12,262 fyke nets; 103 dip nets; 34 cast nets; 475 otter trawls used for shrimp, having an aggregate width at mouth of 8,048 yards; 65 eel pots; 1,510 crab pots; 2,328 sea crawfish pots; 76 spears; 2 steam clam dredges; 672 tongs; 18 rakes; 77 forks; 247 sponge hooks; 57 sea crawfish hooks; 44 stone crab hooks; and 52 diving outfits.

CATCH BY SPECIES

Based on the value to the fishermen, mullet, with a catch of 30,016,056 pounds, valued at $1,252,605, was the most important of the fish taken. Red snapper was next in importance with a catch of 7,938,253 pounds, valued at $642,856. Squeteague or "sea trout" was third, with a catch of 3,920,946 pounds, valued at $362,804. Other fishes of importance were Spanish mackerel, 5,302,199 pounds, valued at $349,893; catfish and bullheads, 5,821,635 pounds, valued at $239,636; kingfish or "king mackerel," 3,948,567 pounds, valued at $205,397; and pompano, 702,955 pounds, valued at $162,097. Other species of fish were valued individually at less than $150,000. Among the shellfish, shrimp was the most important in value with a catch of 25,384,360 pounds, valued at $980,100. Oysters were next in importance with a catch of 3,537,723 pounds of meats, valued at $254,753. Among the sponges, sheepswool were most important, with a catch of 345,586 pounds, valued at $778,497. The yellow sponge ranked next in importance, with a catch of 87,206 pounds, valued at $38,323.

CATCH BY GEAR

On the east coast, where 67,040,079 pounds of fishery products were taken, otter trawls accounted for 34 per cent of the catch; purse seines, 33 per cent; gill nets, 17 per cent; and lines, 7 per cent. The catch by otter trawls was principally shrimp; that by purse seines menhaden; that by gill nets mainly mullet, Spanish mackerel, and squeteague or "sea trout"; and that by lines chiefly kingfish or "king mackerel," and catfish and bullheads.

On the west coast where 61,120,555 pounds were taken, gill nets accounted for 36 per cent of the catch; lines, 24 per cent; haul seines, 12 per cent; and purse seines, 9 per cent. The catch by gill nets consisted principally of mullet, Spanish mackerel, and squeteague or "sea trout"; that by lines chiefly red snapper, groupers and kingfish or "king mackerel"; that by haul seines mainly mullet and Spanish mackerel; and that by purse seines, menhaden.

In Lake Okeechobee, where 3,677,386 pounds were taken, haul seines accounted for 89 per cent of the catch; fyke nets, 9 per cent; and lines, 2 per cent. The catch by haul seines was principally catfish and bullheads; that by fyke nets chiefly black bass and crappie; and that by lines mainly catfish and bullheads.

Considering the fisheries of the State as a whole, five types of gear accounted for 90 per cent of the catch. Listed in order of their importance these were gill nets, which accounted for 25 per cent; purse seines, 21 per cent; otter trawls, 20 per cent; lines, 15 per cent; and haul seines, 9 per cent. The catch by gill nets consisted principally of mullet, Spanish mackerel, and squeteague or "sea trout"; that by purse seines almost exclusively menhaden; that by otter trawls chiefly shrimp; that by lines mainly red snapper, groupers, and kingfish or "king mackerel"; and that by haul seines principally mullet, Spanish mackerel, catfish, and bullheads.

FISHERIES BY COUNTIES

Based on the selling value as landed, the fisheries of Pinellas County were most important during 1928. During the year 5,794,749 pounds of fishery products, valued at $1,071,016, were taken. Sponges which are taken near Tarpon Springs, constituted the most important fishery item in this county. Mullet also is an important product. Escambia County was second, with a catch of 7,347,248 pounds, valued at $487,926. Red snappers, which are taken in the vessel fisheries from the banks of the Gulf of Mexico, contributed to making this county one of the most important in the State. Nassau County was third with a catch of 33,567,523 pounds, valued at $483,924. Shrimp, which are taken in the waters near Fernandina and landed at that point, are of great importance in the fisheries of this county. The catch of menhaden which are utilized in the reduction plants near Fernandina are also of great importance. The fisheries of Franklin County ranked fourth in importance, with a catch of 7,681,639 pounds, valued at $414,658. Apalachicola is the center of the fisheries in this county, and oysters and shrimp were the most important products. Other counties where the catch was valued at over $250,000 were St. Johns, Charlotte, and Bay.

Fisheries of Florida, 1928

SUMMARY OF CATCH

Products	East coast		West coast		Lake Okeechobee		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Fish	43, 284, 990	$1, 270, 369	53, 743, 827	$2, 595, 200	3, 671, 386	$168, 983	100, 700, 203	$4, 034, 552
Shellfish, etc	23, 755, 089	944, 470	7, 376, 728	1, 271, 278	6, 000	60	31, 137, 817	2, 215, 808
Total	67, 040, 079	2, 214, 839	61, 120, 555	3, 866, 478	3, 677, 386	169, 043	131, 838, 020	6, 250, 360

OPERATING UNITS: BY DISTRICTS

Items	East coast	West coast	Lake Okeechobee	Total
Fishermen:	*Number*	*Number*	*Number*	*Number*
On vessels	190	764		954
On boats and shore—				
Regular	2, 555	4, 790	276	7, 621
Casual	281	242		523
Total	3, 026	5, 796	276	9, 098
Vessels:				
Motor	25	83		108
Net tonnage	469	2, 665		3, 134
Sail		13		13
Net tonnage		781		781
Total vessels	25	96		121
Total net tonnage	469	3, 446		3,915
Boats:				
Motor	1, 202	1, 960	86	3, 248
Other	1, 131	2, 856	256	4, 242
Accessory boats	14	6		20

Fisheries of Florida, 1928—Continued

OPERATING UNITS: BY DISTRICTS—Continued

Items	East coast	West coast	Lake Okeechobee	Total
Apparatus:				
Purse seines—	*Number*	*Number*	*Number*	*Number*
Menhaden	4	2		6
Yards	1,200	560		1,760
Other	3			3
Yards	900			900
Haul seines—				
Common	78	164	34	276
Yards	54,130	63,865	30,750	148,745
Gill nets—				
Drift	944	1,853		2,797
Square yards	1,507,500	1,840,836		3,348,336
Set	6	12		18
Square yards	7,200	5,100		12,300
Trammel nets	3	254		257
Square yards	1,350	215,460		216,810
Lines—				
Hand	539	1,716	5	2,260
Hooks	569	2,642	5	3,216
Troll	753	326		1,079
Hooks	1,427	478		1,905
Trot with hooks	356	6	7	369
Hooks	58,600	1,000	2,500	62,100
Trot with baits or snoods	2			2
Baits or snoods	1,000			1,000
Pound nets	21	10		31
Stop nets		240		240
Square yards		39,750		39,750
Fyke nets	22	240	12,400	12,662
Dip nets, common	46	57		103
Cast nets	19	15		34
Otter trawls, shrimp	353	122		475
Yards at mouth	6,673	1,375		8,048
Pots—				
Eel	65			65
Crab		1,510		1,510
Sea crawfish	1,998	330		2,328
Spears	10	66		76
Dredges, clam		2		2
Tongs	94	578		672
Rakes		18		18
Forks	62	15		77
Hooks—				
Sponge		247		247
Sea crawfish		57		57
Stone crab	44			44
Diving apparatus		52		52

CATCH: BY DISTRICTS

Species	East coast		West coast		Lake Okeechobee		Total	
FISH	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives	370,128	$2,935					370,128	$2,935
Amberjack	11,847	530	17,342	$584			29,189	1,114
Barracuda	12,000	360	4,000	120			16,000	480
Black bass	140,616	16,241	2,200	220	424,870	$41,591	567,686	58,052
Bluefish	599,020	68,454	390,270	27,502			989,290	95,956
Blue runner or hardtail	123,324	4,177	418,892	11,541			542,216	15,718
Bonito	2,000	300	9,036	324			11,036	624
Butterfish	1,440	43	20,702	828			22,142	871
Cabio or crab eater	200	10	17,677	619			17,877	629
Catfish and bullheads	3,203,091	130,601	99,005	3,454	2,519,539	105,581	5,821,635	239,636
Cero	5,000	250	12,000	530			17,000	780
Cigarfish			116,500	3,215			116,500	3,215
Crappie	387,457	27,212			630,485	18,916	1,017,942	46,128
Crevalle	213,736	6,483	76,498	2,560			290,234	9,043
Croaker	43,839	1,458	42,004	1,593			85,843	3,051
Dolphin	6,000	600	139	14			6,139	614
Drum, black	125,450	3,556	39,321	1,183			164,771	4,739
Drum, red, or redfish	202,024	9,626	889,338	33,903			1,091,362	43,529
Eels	16,013	646					16,013	646
Flounders	46,557	1,573	99,042	5,935			145,599	7,508
Groupers	146,966	6,402	3,971,341	121,959			4,118,307	128,361
Grunts	38,643	1,531	35,885	1,213			74,528	2,744
Hickory shad	35,480	1,419					35,480	1,419
Hogfish	3,000	90	1,500	45			4,500	135
Jewfish	13,900	401	49,477	1,853			63,377	2,254

Fisheries of Florida, 1928—Continued

CATCH: BY DISTRICTS—Continued

Species	East coast		West coast		Lake Okeechobee		Total	
FISH—continued	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Kingfish or "king mackerel"	2,645,656	$136,717	1,302,911	$68,680			3,948,567	$205,397
King whiting or "kingfish"	376,490	14,142	70,164	2,509			446,654	16,651
Ladyfish	3,000	60	358,889	9,493			361,889	9,553
Menhaden	21,511,600	40,330	5,857,000	39,149			27,368,600	79,479
Mojarro	477,072	21,471	225,260	7,080			702,332	28,551
Moonfish	192	5	701	21			893	26
Mullet	6,526,794	254,688	23,489,262	997,917			30,016,056	1,252,605
Muttonfish	114,900	10,182	34,600	3,460			149,500	13,642
Permit	3,895	120	33,463	1,086			37,358	1,206
Pigfish	124,078	3,922	55,144	1,982			179,222	5,904
Pike	2,000	100					2,000	100
Pinfish or sailors choice	179,301	5,024	22,871	862			202,172	5,886
Pompano	283,889	78,374	419,066	83,723			702,955	162,097
Porgies	22,000	760	97,324	2,955			119,324	3,715
Porkfish			600	18			600	18
Sawfish			45,000	375			45,000	375
Sea bass	38,169	4,213	15,560	1,156			53,729	5,369
Shad	690,932	104,436					690,932	104,436
Sharks			226,500	2,552			226,500	2,552
Sheepshead, salt-water	75,744	3,514	499,322	18,963			575,066	22,477
Snapper:								
Mangrove	89,505	4,870	185,661	7,334			275,166	12,204
Red	47,050	4,629	7,891,203	638,227			7,938,253	642,856
Snook or sergeantfish	250,994	12,265	370,487	12,609			621,481	24,874
Spadefish	11,904	381	66,441	2,301			78,345	2,682
Spanish mackerel	2,074,382	135,909	3,227,817	213,984			5,302,199	349,893
Spot	228,153	7,145	108,205	3,922			336,358	11,067
Squeteagues or "sea trout"	1,238,494	118,880	2,682,452	243,924			3,920,946	362,804
Sturgeon			16,247	2,097			16,247	2,097
Sunfish	456,231	18,144			96,492	$2,895	552,723	21,039
Tang			150	4			150	4
Tripletail	400	16	7,000	500			7,400	516
Turbot			200	6			200	
Yellowtail	64,434	5,174	122,158	9,116			186,592	14,290
Total	43,284,990	1,270,369	53,743,827	2,595,200	3,671,386	168,983	100,700,203	4,034,552
SHELLFISH, ETC.								
Crabs:								
Hard	134,276	7,334	6,900	731			141,176	8,065
Stone	35,000	3,850	76,940	11,836			111,940	15,686
Sea crawfish or spiny lobster	367,106	29,368	197,056	15,154			564,162	44,522
Shrimp	22,507,186	864,614	2,877,174	115,486			25,384,360	980,100
Clams, hard	25,840	3,092	750,728	48,993			776,568	52,085
Oysters, market, public	577,787	30,141	2,856,476	218,372			3,434,263	248,513
Oysters, market, private	101,360	5,940	2,100	300			103,460	6,240
Scallops:								
Bay			14,100	5,000			14,100	5,000
Sea			2,100	1,050			2,100	1,050
Terrapin			461	115			461	115
Turtles	6,534	131	22,735	1,756	6,000	60	35,269	1,947
Sponges:								
Grass			108,876	27,774			108,876	27,774
Sheepswool			345,586	778,497			345,586	778,497
Wire			12,690	6,768			12,690	6,768
Yellow			87,206	38,323			87,206	38,323
Conchs			15,600	1,123			15,600	1,123
Total	23,755,089	944,470	7,376,728	1,271,278	6,000	60	31,137,817	2,215,808

PRODUCTION OF CERTAIN SHELLFISH SHOWN IN NUMBERS AND BUSHELS

Products		East coast		West coast		Total	
		Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Crabs:							
Hard	number	402,828	$7,334	20,700	$731	423,528	$8,065
Stone	do	46,667	3,850	102,587	11,836	149,254	15,686
Clams, hard	bushels	3,230	3,092	93,841	48,993	97,071	52,085
Oysters, market, public	do	82,541	30,141	408,068	218,372	490,609	248,513
Oysters, market, private	do	14,480	5,940	300	300	14,780	6,240
Scallops:							
Bay	do			2,350	5,000	2,350	5,000
Sea	do			350	1,050	350	1,050

INDUSTRIES RELATED TO THE FISHERIES [7]

Transporting trade.—During 1928 there were 48 persons in Florida engaged in transporting the products from fishing grounds to the market. In this trade 20 motor vessels, having total capacity of 311 net tons, were operated.

Wholesale trade.—In 1928 there were 218 wholesale establishments in Florida engaged chiefly in handling fresh and frozen products. These establishments employed 1,277 persons, who received $908,280 in salaries and wages. Of the total number, 110 were on the west coast, 101 on the east coast, and 7 on Lake Okeechobee.

Prepared products and by-products.—There were 18 establishments in Florida during 1928 engaged in canning and curing fishery products or in manufacturing fishery by-products. These employed 429 persons who received $331,568 in salaries and wages. The products manufactured were valued at $1,721,699. These products consisted principally of canned shrimp and oysters, and menhaden products. There was also a production of canned turtle and clam products, salted mullet and mullet roe, oyster-shell products, pickled shrimp, sawfish fins, and shark hides and oil. In addition, 428,554 pounds of salted mullet and mullet roe, valued at $25,467, were prepared by the fishermen.

Industries related to the fisheries of Florida, 1928

Items	East coast	West coast	Lake Okeechobee	Total
Transporting:				
Persons engaged	1	47		48
Vessels, motor	1	19		20
Net tonnage	16	295		311
Wholesale trade:				
Establishments	101	110	7	218
Persons engaged	582	667	28	1,277
Salaries and wages paid	$360,562	$528,088	$19,630	$908,280
Prepared products and by-products industries:				
Establishments	8	10		18
Persons engaged	197	232		429
Salaries and wages paid	$184,547	$147,021		$331,568
Products	$1,038,089	$683,610		$1,721,699
Products prepared by fishermen		$25,467		$25,467

LAKE OKEECHOBEE

In 1928 there were 304 persons engaged in fisheries or in the fishery industries of Lake Okeechobee. This is an increase of 23 per cent over the number of persons engaged during 1927. Of the total number in 1928, 276 were fishermen and 28 were engaged in the wholesale fishery trade. The catch amounted to 3,677,386 pounds, valued at $169,043. This represents a decrease of 16 per cent both in the catch and its value, as compared with the catch and its value in 1927. The catch consisted of 2,519,539 pounds of catfish and bullheads, valued at $105,581; 630,485 pounds of crappie, valued at $18,916; 424,870 pounds of black bass, valued at $41,591; 96,492 pounds of sunfish, valued at $2,895; and 6,000 pounds of turtles, valued at $60.

[7] See pp. 909 and 940, respectively, for detailed statistics on this subject, for the east and west coasts of Florida and for Lake Okeechobee on p. 920.

OPERATING UNITS

The catch of fishery products in Lake Okeechobee was taken by 276 fishermen who used 342 motor and other fishing boats, 34 haul seines, having a total length of 30,750 yards, 12,400 fykes, 5 hand-lines, and 7 trot lines.

CATCH BY GEAR

Haul seines accounted for 89 per cent of the catch; fyke nets, 9 per cent; and lines, 2 per cent. The catch by haul seines was principally catfish and bullheads, that by fyke nets chiefly black bass and crappie, and that by lines mainly catfish and bullheads.

CATCH BY COUNTIES

The catch in Lake Okeechobee was taken in three counties. Glades County accounted for 69 per cent of the catch and 72 per cent of the value of the catch; Okeechobee County, 28 per cent of the catch and 25 per cent of the value; and Palm Beach, 3 per cent of the catch and 3 per cent of the value.

INDUSTRIES RELATED TO THE FISHERIES

During 1928 no vessels were operated in the transporting trade in Lake Okeechobee nor were any prepared-products or by-products industries located there.

Wholesale trade.—There were seven wholesale establishments on the shores of Lake Okeechobee in 1928 handling fresh fishery products. These employed 28 persons, who received $19,630 in salaries and wages.

Fisheries and related industries of Lake Okeechobee, Fla., 1928

OPERATING UNITS: BY GEAR

Items	Haul seines, common	Lines		Fykes	Total, exclusive of duplication
		Hand	Trot with hooks		
	Number	*Number*	*Number*	*Number*	*Number*
Fishermen: On boats and shore, regular	172	5	7	103	276
Boats:					
Motor	64	2	4	22	86
Other	152	4	3	103	256
Apparatus:					
Number	34	5	7	12,400	
Length, yards	30,750				
Hooks		5	2,500		

CATCH: BY GEAR

Species	Haul, seines, common		Lines				Fykes		Total	
			Hand		Trot with hooks					
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Black bass	247,870	$23,991	2,000	$200			175,000	$17,400	424,870	$41,591
Catfish and bullheads	2,424,995	101,646			63,635	$2,650	30,909	1,285	2,519,539	105,581
Crappie	519,485	15,586					111,000	3,330	630,485	18,916
Sunfish	92,492	2,775					4,000	120	96,492	2,895
Turtles	6,000	60							6,000	60
Total	3,290,842	144,058	2,000	200	63,635	2,650	320,909	22,135	3,677,386	169,043

Fisheries and related industries of Lake Okeechobee, Fla., 1928—Continued

OPERATING UNITS: BY COUNTIES

Items	Glades	Okeechobee	Palm Beach
	Number	*Number*	*Number*
Fishermen: On boats and shore, regular	212	54	10
Boats:			
Motor	62	20	4
Other	198	50	8
Apparatus:			
Haul seines, common	20	12	2
Yards	18,750	10,200	1,800
Lines—			
Hand	5		
Hooks	5		
Trot with hooks	6	1	
Hooks	2,200	300	
Fykes	11,700	700	

CATCH: BY COUNTIES

Species	Glades		Okeechobee		Palm Beach	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Black bass	373,172	$37,320	44,898	$3,591	6,800	$680
Catfish and bullheads	1,734,074	71,242	705,080	31,023	80,385	3,316
Crappie	357,884	10,737	234,351	7,031	38,250	1,148
Sunfish	50,992	1,530	42,000	1,260	3,500	105
Turtles	6,000	60				
Total	2,522,122	120,889	1,026,329	42,905	128,935	5,249

WHOLESALE FISHERY TRADE

Items	Glades County	Okeechobee and Palm Beach Counties	Total
Establishments	3	4	7
Persons engaged:			
Proprietors	3	4	7
Salaried employees	3		3
Wage earners	12	6	18
Paid to salaried employees	$3,980	$2,400	$6,380
Paid to wage earners	8,622	4,628	13,250
Total salaries and wages	12,602	7,028	19,630

SPONGE FISHERY

In the waters along the Gulf coast of Florida is located the only commercial sponge fishery in the United States. During 1928 this fishery employed 816 fishermen, which is 6 per cent more than the number employed during 1927. Their catch amounted to 554,358 pounds, valued at $851,362. This represents a decrease of 8 per cent in the catch and 18 per cent in the value of the catch, as compared with the catch and its value for the previous year. The greater part of the catch consisted of sheepswool sponges, although there were considerable quantities of grass and yellow varieties, and a small production of wire sponges.

OPERATING UNITS

In making the catch the fishermen employed 4 motor vessels, 1 sailing vessel, 319 motor and other small boats, 247 sponge hooks, and 52 diving outfits. The vessels had a combined capacity of 77 net tons.

MARKETING OF SPONGES

The greater proportion of the catch landed at Tarpon Springs is marketed through the Sponge Exchange located there. During 1928 sponges to the amount of 413,198 pounds, valued at $729,918, were handled there. This is 75 per cent of the volume of the entire Florida catch and 86 per cent of the value. Transactions are made on the exchange at auction, and bidders represent merchants in various sections of this and foreign countries.

Our imports of sponges in 1928, which originated almost entirely in Cuba, amounted to 933,232 pounds, valued at $1,124,297, while our exports during the same year, which were forwarded mainly to the United Kingdom, Argentina, Canada, and France amounted to 114,917 pounds, valued at $146,520. The net consumption of sponges in 1928 in the United States, after adding the volume of the imports for domestic consumption to the domestic production and subtracting the exports, amounted to 1,372,673 pounds, valued at $1,829,139.

Sponges are utilized in the arts and industries, such as in applying a glaze to pottery, for the toilet, and for cleaning automobiles and other vehicles. Some also are used in surgical work.

In 1929 the quantity of sponges sold on the exchange at Tarpon Springs was 378,514 pounds, valued at $706,645. This is a decrease of 8 per cent in quantity and 3 per cent in value as compared with the quantity and value of the transactions on the exchange during 1928. It is estimated that the value of sponges sold outside the exchange during 1929 amounted to about $75,000. Of the total quantity sold on the exchange in 1929, 206,338 pounds, valued at $606,844, were large wool; 32,635 pounds, valued at $48,952, were small wool; 68,776 pounds, valued at $32,096, were yellow; 59,705 pounds, valued at $14,329, were grass; and 11,060 pounds, valued at $4,424, were wire.

Sponge fishery of Florida, 1928

OPERATING UNITS: BY GEAR

Items	Sponge hooks	Diving outfits	Total
Fishermen:	*Number*	*Number*	*Number*
On vessels	44		44
On boats and shore, regular	368	404	772
Total	412	404	816
Vessels:			
Motor—			
5 to 10 tons	1		1
11 to 20 tons	2		2
21 to 30 tons	1		1
Total	4		4
Net tonnage	52		52

Items	Sponge hooks	Diving outfits	Total
Sail:	*Number*	*Number*	*Number*
5 to 10 tons	1		1
11 to 20 tons	1		1
Total	2		2
Net tonnage	25		25
Total vessels	6		6
Total net tonnage	77		77
Boats:			
Motor	97	52	149
Other	170		170
Apparatus	247	52	

CATCH: BY GEAR

Sponges	Sponge hooks		Diving outfits		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Sheepswool	94,627	$136,505	250,959	$641,992	345,586	$778,497
Yellow	26,312	9,956	60,894	28,367	87,206	38,323
Grass	53,939	12,391	54,937	15,383	108,876	27,774
Wire	1,269	677	11,421	6,091	12,690	6,768
Total	176,147	159,529	378,211	691,833	554,358	851,362

Sponges sold at the exchange, Tarpon Springs, Fla., 1926 to 1929, and the 5-year average 1921–1925

Year	Large wool		Small wool		Yellow	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
1921–1925 (average)	234, 568	$574, 465	55, 309	$49, 663	95, 143	$40, 246
1926	235, 143	592, 367	26, 073	36, 502	55, 205	22, 682
1927	252, 463	752, 435	35, 413	61, 973	65, 429	32, 714
1928	232, 208	623, 776	33, 744	50, 616	61, 358	28, 633
1929	206, 338	606, 844	32, 635	48, 952	68, 776	32, 096

Year	Grass		Wire		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
1921–1925 (average)	56, 586	$11, 931	11, 084	$4, 381	452, 690	$680, 686
1926	49, 233	13, 441	2, 091	1, 101	367, 745	666, 093
1927	50, 495	14, 139	10, 617	4, 249	414, 417	865, 510
1928	74, 698	20, 925	11, 190	5, 968	413, 198	729, 918
1929	59, 705	14, 329	11, 060	4, 424	378, 514	706, 645

FISHERIES OF THE GULF STATES, 1928

During 1928 the catch of fishery products in the Gulf States exceeded that in any year for which there are records, except that in 1927. These fisheries gave employment to 16,356 fishermen or 8 per cent more than in 1927. Of the total number of fishermen employed during 1928, 2,400 regular fishermen were engaged on vessels, and 13,033 regular and 923 casual fishermen were employed in the shore and boat fisheries. Their catch amounted to 191,007,176 pounds, valued at $9,866,263. This is a decrease of 2 per cent in the catch and 1 per cent in the value of the catch as compared with the quantity and its value for 1927. Of the total catch in 1928, 67,704,097 pounds, valued at $3,673,124, were fish, and 123,303,079 pounds, valued at $6,193,139, were shellfish and miscellaneous products.

Based on the value to the fishermen, shrimp with a production of 82,169,863 pounds, valued at $3,092,417, was the most important product. Oysters were second with a production of 34,942,614 pounds of meats, valued at $1,943,239. Other products of importance were mullet, 26,447,649 pounds, valued at $1,111,921; red snapper, 10,392,215 pounds, valued at $860,430; sponges, 554,358 pounds, valued at $851,362; and squeteagues or "sea trout," 5,339,636 pounds, valued at $564,433. Other products were valued individually at less than $300,000.

The industries related to the fisheries of the Gulf States gave employment to 4,528 persons, of whom 85 were engaged in transporting fishery products, 1,768 were in the wholesale trade and received $1,319,912 in salaries and wages, and 2,675 were in the prepared-products and by-products trade and received $1,567,748 in salaries and wages. There were 250 establishments in the wholesale fish trade handling primary products and 97 establishments were in the prepared-products and by-products trade. The latter manufactured products valued at $8,131,857, consisting principally of canned shrimp and oysters. In addition, individual fishermen in the Gulf States prepared fishery products, valued at $30,910. Most of these products were salted mullet and salted mullet roe.

Fisheries of the Gulf States, 1928

SUMMARY OF CATCH

Products	Florida (west coast)		Alabama		Mississippi	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Fish	53, 743, 827	$2, 595, 200	4, 170, 403	$251, 350	2, 138, 670	$133, 826
Shellfish, etc	7, 376, 728	1, 271, 278	10, 296, 077	335, 445	28, 561, 999	926, 240
Total	61, 120, 555	3, 866, 478	14, 466, 480	586, 795	30, 700, 669	1, 060, 066

Products	Louisiana		Texas		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Fish	2, 322, 007	$220, 890	5, 329, 190	$471, 858	67, 704, 097	$3, 673, 124
Shellfish, etc	67, 184, 972	3, 256, 976	9, 883, 303	403, 200	123, 303, 079	6, 193, 139
Total	69, 506, 979	3, 477, 866	15, 212, 493	875, 058	191, 007, 176	9, 866, 263

OPERATING UNITS: BY STATES

Items	Florida (west coast)	Alabama	Mississippi	Louisiana	Texas	Total
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	764	202	753	506	175	2, 400
On boats and shore:						
Regular	4, 790	610	1, 443	4, 571	1, 619	13, 033
Casual	242	46	7	75	553	923
Total	5, 796	858	2, 203	5, 152	2, 347	16, 356
Vessels:						
Motor	83	44	97	185	45	454
Net tonnage	2, 665	487	1, 105	1, 360	470	6, 087
Sail	13		44	3	4	64
Net tonnage	781		747	30	130	1, 688
Total vessels	96	44	141	188	49	518
Total net tonnage	3, 446	487	1, 852	1, 390	600	7, 775
Boats:						
Motor	1, 960	260	553	1, 542	569	4, 884
Other	2, 856	271	526	1, 167	832	5, 652
Accessory	6					6
Apparatus:						
Purse seines, menhaden	2					2
Yards	560					560
Haul seines—						
Common	164	15	27	292	94	592
Yards	63, 865	5, 200	6, 700	56, 665	18, 686	151, 116
Long					92	92
Yards					29, 332	29, 332
Gill nets—						
Drift	1, 853					1, 853
Square yards	1, 840, 836					1, 840, 836
Set	12	32			541	585
Square yards	5, 100	5, 400			98, 496	108, 996
Trammel nets	254	136	86	103	108	687
Square yards	215, 460	40, 800	27, 396	26, 299	42, 078	352, 033
Lines—						
Hand	1, 716	160	105	342	799	3, 122
Hooks	2, 642	302	121	347	898	4, 310
Trot with hooks	6	118			276	400
Hooks	1, 000	11, 500			43, 400	55, 900
Trot with baits or snoods		17	105	293	36	451
Baits or snoods		4, 400	35, 588	71, 350	9, 280	120, 618
Troll	326					326
Hooks	478					478
Pound nets	10					10
Stop nets	240					240
Square yards	39, 750					39, 750
Fyke nets	240	96				336
Dip nets—						
Common	57		60		30	147
Drop			400	11,340	200	11, 940
Cast nets	15		35		9	59
Otter trawls, shrimp	122	178	470	1, 151	262	2, 183
Yards at mouth	1, 375	2, 268	5, 697	14, 717	3, 909	27, 966

Fisheries of the Gulf States, 1928—Continued

OPERATING UNITS: BY STATES—Continued

Items	Florida (west coast)	Alabama	Mississippi	Louisiana	Texas	Total
Apparatus—Continued.						
Pots—	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Crab	1,510					1,510
Crawfish	330					330
Spears	66	77	118		165	426
Dredges—						
Clam	2					2
Oyster			266	86	52	404
Yards at mouth			327	90	52	469
Tongs	578	245	570	611	407	2,411
Rakes	18					18
Forks	15					15
Hooks—						
Sponge	247					247
Sea crawfish	57					57
Diving apparatus	52					52

CATCH: BY STATES

Species	Florida (west coast)		Alabama		Mississippi	
FISH	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Amberjack	17,342	$584				
Barracuda	4,000	120				
Black bass	2,200	220	1,067	$127		
Bluefish	390,270	27,502	31,464	2,088	26,663	$1,554
Blue runner or hardtail	418,892	11,541	22,080	882	4,000	120
Bonito	9,036	324				
Buffalofish			37,686	1,507		
Butterfish	20,702	828				
Cabio or crab eater	17,677	619			4,950	159
Catfish and bull heads	99,005	3,454	111,057	6,538	90,584	3,674
Cero	12,000	530				
Cigarfish	116,500	3,215				
Crevalle	76,498	2,560	5,800	173	2,300	71
Croaker	42,004	1,593	46,328	1,457	56,340	2,332
Dolphin	139	14				
Drum, black	39,321	1,183	7,703	322	62,553	2,715
Drum, red, or redfish	889,338	33,903	49,407	3,958	207,988	18,737
Flounders	99,042	5,935	33,831	3,494	67,010	8,427
Groupers	3,971,341	121,959	198,501	7,124	49,300	1,479
Grunts	35,885	1,213				
Hogfish	1,500	45				
Jewfish	49,477	1,853	3,400	121	5,700	171
Kingfish or "king mackerel"	1,302,911	68,680			1,000	40
King whiting or "kingfish"	70,164	2,509	900	27	34,021	1,157
Ladyfish	358,889	9,493				
Menhaden	5,857,000	39,149				
Mojarro	225,260	7,080				
Moonfish	701	21				
Mullet	23,489,262	997,917	2,118,341	84,878	802,546	27,756
Muttonfish	34,600	3,460				
Paddlefish or spoonbill cat			2,641	158		
Permit	33,463	1,086				
Pigfish	55,144	1,982			1,300	49
Pinfish or sailors choice	22,871	862				
Pompano	419,066	83,723	5,514	981	3,979	639
Porgies	97,324	2,955				
Porkfish	600	18				
Sawfish	45,000	375				
Sea bass	15,560	1,156			8,780	859
Sharks	226,500	2,552			6,000	180
Sheepshead, salt-water	499,322	18,963	37,528	3,006	80,269	6,544
Snapper, mangrove	185,661	7,334				
Snapper, red	7,891,203	638,227	1,300,522	118,655	97,328	8,036
Snook or sergeantfish	370,487	12,609	22	2		
Spadefish	66,441	2,301	3,190	127	3,420	115
Spanish mackerel	3,227,817	213,984	4,339	403	9,242	1,164
Spot	108,205	3,922	10,833	287	25,900	992
Squeteagues or "sea trout"	2,682,452	243,924	125,258	12,706	487,497	46,856
Sturgeon	16,247	2,097	9,666	2,100		
Sunfish			1,725	69		
Tang	150	4				
Tripletail	7,000	500	1,600	160		
Turbot	200	6				
Yellowtail	122,158	9,116				
Total	53,743,827	2,595,200	4,170,403	251,350	2,138,670	133,826

Fisheries of the Gulf States, 1928—Continued

CATCH: BY STATES—Continued

Species	Florida (west coast)		Alabama		Mississippi	
SHELLFISH, ETC.	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Crabs, hard	6,900	$731	101,836	$4,226	1,517,639	$39,789
Crabs, soft			3,200	800	66,816	12,016
Crabs, stone	76,940	11,836				
Sea crawfish or spiny lobster	197,056	15,154				
Shrimp	2,877,174	115,486	5,972,489	179,174	11,706,525	377,248
Clams, hard	750,728	48,993				
Oysters, market, public	2,856,476	218,372	4,074,147	140,823	[1] 14,033,894	474,613
Oysters, market, private	2,100	300	143,976	10,284	159,180	15,610
Oysters, seed, public					1,016,547	6,512
Scallops, bay	14,100	5,000				
Scallops, sea	2,100	1,050				
Terrapin	461	115	429	138	1,398	452
Turtles	22,735	1,756				
Sponges:						
Grass	108,876	27,774				
Sheepswool	345,586	778,497				
Wire	12,690	6,768				
Yellow	87,206	38,323				
Conchs	15,600	1,123				
Total	7,376,728	1,271,278	10,296,077	335,445	28,561,999	926,240
Grand total	61,120,555	3,866,478	14,466,480	586,795	30,700,669	1,060,066

Species	Louisiana		Texas		Total	
FISH	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Amberjack					17,342	$584
Barracuda					4,000	120
Black bass					3,267	347
Bluefish	200	$30	700	$70	449,297	31,244
Blue runner or hardtail					444,972	12,543
Bonito					9,036	324
Buffalofish	3,200	310	88,490	4,978	129,376	6,795
Butterfish			1,000	30	21,702	858
Cabio or crab eater					22,627	778
Catfish and bullheads	340,197	17,074	311,279	14,895	952,122	45,635
Cero					12,000	530
Cigarfish					116,500	3,215
Crevalle			1,246	50	85,844	2,854
Croaker	168,500	8,556	84,880	3,783	398,052	17,721
Dolphin					139	14
Drum, black	163,300	8,720	996,470	40,495	1,269,347	53,435
Drum, red, or redfish	433,574	46,738	1,029,882	113,080	2,610,189	216,416
Flounders	12,895	1,642	52,402	6,590	265,180	26,088
Garfish	9,000	900			9,000	900
Groupers	500	30	21,617	698	4,241,259	131,290
Grunts					35,885	1,213
Hogfish					1,500	45
Jewfish	2,000	120	75,746	4,477	136,323	6,742
Kingfish or "king mackerel"			11,300	484	1,315,211	69,204
King whiting or "kingfish"	61,550	2,646	23,896	1,397	190,531	7,736
Ladyfish					358,889	9,493
Menhaden					5,857,000	39,149
Mojarro					225,260	7,080
Moonfish					701	21
Mullet	23,100	965	14,400	405	26,447,649	1,111,921
Muttonfish					34,600	3,460
Paddlefish or spoonbill cat					2,641	158
Permit					33,463	1,086
Pigfish					56,444	2,031
Pinfish or sailors choice					22,871	862
Pompano	1,850	304	10,895	2,474	441,304	88,121
Porgies					97,324	2,955
Porkfish					600	18
Sawfish					45,000	375
Sea bass	1,500	150	3,950	341	29,790	2,506
Sharks					232,500	2,732
Sheepshead, salt-water	108,190	11,929	54,764	3,857	780,073	44,299
Sheepshead, fresh-water			6,800	411	6,800	411

[1] Includes 7,661,248 pounds (1,094,464 bushels), valued at $228,348, taken from beds in Louisiana by Mississippi vessels.

Fisheries of the Gulf States, 1928—Continued

CATCH: BY STATES—Continued

Species	Louisiana		Texas		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Snapper, mangrove					185,661	$7,334
Snapper, red	48,000	$6,720	1,055,162	$88,792	10,392,215	860,430
Snook or sergeantfish			230,275	22,276	600,784	34,887
Spadefish	100	6	4,825	249	77,976	2,798
Spanish mackerel	22,171	3,084	88,264	10,069	3,351,833	228,704
Spot	34,850	1,823			179,788	7,024
Squeteagues or "sea trout"	884,530	109,031	1,159,899	151,916	5,339,636	564,433
Sturgeon					25,913	4,197
Sunfish					1,725	69
Tang					150	4
Tripletail					8,600	660
Tuna or horse mackerel			1,048	41	1,048	41
Turbot					200	6
Yellowtail	2,800	112			124,958	9,228
Total	2,322,007	220,890	5,329,190	471,858	67,704,097	3,673,124
SHELLFISH, ETC.						
Crabs, hard	2,320,130	78,610	300,500	12,065	4,247,005	135,421
Crabs, soft	182,960	52,424			252,976	65,240
Crabs, stone					76,940	11,836
Sea crawfish or spiny lobster					197,056	15,154
Shrimp	53,779,403	2,159,359	7,774,272	261,150	82,169,863	3,092,417
Clams, hard					750,728	48,993
Oysters, market, public	1,506,113	53,433	1,760,381	123,255	24,231,011	1,010,496
Oysters, market, private	9,342,550	893,334	47,250	6,703	9,695,056	926,231
Oysters, seed, public					1,016,547	6,512
Scallops, bay					14,100	5,000
Scallops, sea					2,100	1,050
Terrapin	53,816	19,816			56,104	20,521
Turtles			900	27	23,635	1,783
Sponges:						
Grass					108,876	27,774
Sheepswool					345,586	778,497
Wire					12,690	6,768
Yellow					87,206	38,323
Conchs					15,600	1,123
Total	67,184,972	3,256,976	9,883,303	403,200	123,303,079	6,193,139
Grand total	69,506,979	3,477,866	15,212,493	875,058	191,007,176	9,866,263

PRODUCTION OF CERTAIN SHELLFISH SHOWN IN NUMBERS AND BUSHELS

Products	Florida (west coast)		Alabama		Mississippi	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Crabs, hard .... number	20,700	$731	305,508	$4,226	4,552,917	$39,789
Crabs, soft .... do			9,600	800	200,448	12,016
Crabs, stone .... do	102,587	11,836				
Clams, hard .... bushels	93,841	48,993				
Oysters, market, public .... do	408,068	218,372	582,021	140,823	2,004,842	474,613
Oysters, market, private .... do	300	300	20,568	10,284	22,740	15,610
Oysters, seed, public .... do					145,221	6,512
Scallops, bay .... do	2,350	5,000				
Scallops, sea .... do	350	1,050				

Products	Louisiana		Texas		Total	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Crabs, hard .... number	6,960,390	$78,610	901,500	$12,065	12,741,015	$135,421
Crabs, soft .... do	548,880	52,424			758,928	65,240
Crabs, stone .... do					102,587	11,836
Clams, hard .... bushels					93,841	48,993
Oysters, market, public .... do	215,159	53,433	251,483	123,255	3,461,573	1,010,496
Oysters, market, private .... do	1,334,650	893,334	6,750	6,703	1,385,008	926,231
Oysters, seed, public .... do					145,221	6,512
Scallops, bay .... do					2,350	5,000
Scallops, sea .... do					350	1,050

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Industries related to the fisheries of the Gulf States, 1928

Items	Florida (west coast)	Alabama	Mississippi	Louisiana	Texas	Total
Transporting:						
Persons engaged	47	6	4	28	----------	85
Vessels—						
Motor	19	2	2	12	----------	35
Net tonnage	295	32	19	135	----------	481
Sail	----------	1	----------	1	----------	2
Net tonnage	----------	7	----------	16	----------	23
Total vessels	19	3	2	13	----------	37
Total net tonnage	295	39	19	151	----------	504
Wholesale trade:						
Establishments	110	17	26	36	61	250
Persons engaged	667	143	233	324	401	1,768
Salaries and wages paid	$528,088	$167,110	$121,295	$286,116	$217,303	$1,319,912
Prepared products and by-products industries:						
Establishments	10	7	23	48	9	97
Persons engaged	232	217	791	1,302	133	2,675
Salaries and wages paid	$147,021	$149,807	$499,794	$677,510	$93,616	$1,567,748
Products	$683,610	$640,772	$1,899,999	$4,577,468	$330,008	$8,131,857
Products prepared by the fishermen	$25,467	$720	$4,723	----------	----------	$30,910

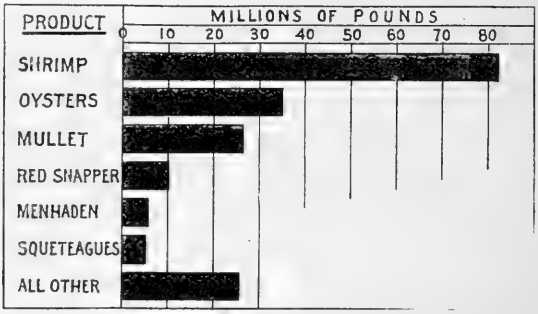

FIGURE 23.—Yield of principal fishery products in the Gulf States, 1928

WEST COAST OF FLORIDA [8]

The west coast of Florida in 1928 ranked second among the States bordering on the Gulf of Mexico with respect to the volume of the catch, employing 36 per cent of the total number of fishermen and accounting for 32 per cent of the total catch. The fisheries and industries related to the fisheries employed 6,742 persons, which is 10 per cent greater than the number in 1927. Of the total, 5,796 were fishermen, 47 were employed on transporting vessels, 677 in the wholesale trade, and 232 in the prepared products and by-products industries.

The total catch amounted to 61,120,555 pounds, valued at $3,866,478. This is a decrease of 17 per cent in the catch and 11 per cent in the value of the catch, compared with the catch and its value for 1927. Of the total value of the catch, that for mullet accounted for 26 per cent; sponges, 22 per cent; red snapper, 17 per cent; and squeteagues or "sea trout," Spanish mackerel, and oysters, each 6 per cent. Of

[8] See pp. 914-923 for complete statistics for Florida.

the total production, that of mullet accounted for 38 per cent; red snapper, 13 per cent; menhaden, 10 per cent; groupers, 6 per cent; and Spanish mackerel, shrimp, and oysters, each 5 per cent.

OPERATING UNITS BY GEAR

The catch of fishery products along the west coast of Florida during 1928 was taken by 5,796 fishermen, who used 83 motor vessels, 13 sailing vessels, 4,816 motor and other boats, and 20 major types of gear. The motor and sailing vessels had a combined capacity of 3,446 net tons. The fisheries accounting for the greatest number of persons were the drift gill-net fishery, employing 1,907 fishermen, and the hand-line fishery, employing 1,664 fishermen.

CATCH BY GEAR

Four types of gear caught 81 per cent of the fish taken in the marine fisheries of the west coast of Florida during 1928. Listed in order of importance they were gill nets, which accounted for 36 per cent of the catch; lines, 24 per cent; haul seines, 12 per cent; and purse seines, 9 per cent.

The catch by gill nets was made up largely of mullet, Spanish mackerel, and squeteagues or "sea trout"; that by lines consisted largely of red snapper, groupers, and kingfish; that by haul seines consisted mainly of mullet, and Spanish mackerel; and that by purse seines was made up entirely of menhaden.

OPERATING UNITS BY COUNTIES

Pinellas County was foremost in the number of persons fishing, accounting for 20 per cent of the total. Franklin County followed with 13 per cent. Other counties employing a considerable number of fishermen, listed in order of their importance in this respect, were: Charlotte, Escambia, Monroe, and Bay. Escambia County accounted for 41 per cent of the total number of fishing vessels and Bay County 23 per cent. Franklin County led in the number of small motor and other types of fishing boats, accounting for 16 per cent of the total. Charlotte County followed with 13 per cent of the total.

CATCH BY COUNTIES

Fishing was prosecuted in the marine waters of 23 counties on the west coast of Florida in 1928. Ranked according to value, the fisheries of Pinellas County were most important, accounting for 9 per cent of the total catch and 28 per cent of the total value of the catch. Escambia County was next in value of catch, accounting for 12 per cent of the quantity and 13 per cent of the total value. Other important counties listed in order with respect to the value of catch were Franklin, Charlotte, Bay, and Monroe.

Fisheries of the west coast of Florida, 1928

OPERATING UNITS: BY GEAR

Items	Purse seines, menhaden	Haul seines, common	Gill nets		Lines		
			Drift	Set	Hand	Trot with hooks	Troll
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	60	6			644		
On boats and shore—							
Regular		879	1,907	15	782	6	194
Casual					238		
Total	60	885	1,907	15	1,664	6	194
Vessels:							
Motor—							
5 to 10 tons		1			11		
11 to 20 tons					21		
21 to 30 tons					6		
31 to 40 tons	1				3		
41 to 50 tons					8		
51 to 60 tons					6		
61 to 70 tons	1				12		
71 to 80 tons					2		
91 to 100 tons					1		
101 to 110 tons					1		
Total	2	1			71		
Net tonnage	96	7			2,740		
Sail—							
31 to 40 tons					3		
51 to 60 tons					3		
61 to 70 tons					3		
131 to 140 tons					1		
141 to 150 tons					1		
Total					11		
Net tonnage					766		
Total vessels	2	1			82		
Total net tonnage	96	7			3,226		
Boats:							
Motor		161	757	2	441	2	133
Other		182	1,649	5	201	6	
Apparatus:							
Number	2	164	1,853	12	1,716	6	326
Length, yards	560	63,865					
Square yards			1,840,836	5,100			
Hooks, baits, or snoods					2,642	1,000	478

Items	Pound nets	Trammel nets	Stop nets	Fyke nets	Dip nets, common	Cast nets
Fishermen:						
On boats and shore—	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Regular	24	394	107	12	51	9
Casual		2			6	6
Total	24	396	107	12	57	15
Boats:						
Motor	6	162	30	6	25	1
Other	16	199	90	12	37	7
Apparatus:						
Number	10	254	240	240	57	15
Square yards		215,460	39,750			

Fisheries of the west coast of Florida, 1928—Continued

OPERATING UNITS: BY GEAR—Continued

Items	Otter trawls, shrimp	Crab pots	Crawfish pots	Spears	Clam dredges	Tongs	Rakes
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	8					4	
On boats and shore—							
Regular	236	26	16	62	19	564	18
Casual				4		10	
Total	244	26	16	66	19	578	18
Vessels:							
Motor—							
5 to 10 tons	3					2	
11 to 20 tons	1						
Total	4					2	
Net tonnage	33					13	
Total vessels	4					2	
Total net tonnage	33					13	
Boats:							
Motor	118	14	3			221	12
Other		19	13			182	18
Apparatus:							
Number	122	1,510	330	66	2	578	18
Yards at mouth	1,375						

Items	Forks	Hooks		Diving apparatus	By hand	Total exclusive of duplication
		Sponge	Sea crawfish			
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels		44				764
On boats and shore—						
Regular	15	368	57	404	29	4,790
Casual					44	242
Total	15	412	57	404	73	5,796
Vessels:						
Motor—						
5 to 10 tons		1				17
11 to 20 tons		2				24
21 to 30 tons		1				7
31 to 40 tons						4
41 to 50 tons						8
51 to 60 tons						6
61 to 70 tons						13
71 to 80 tons						2
91 to 100 tons						1
101 to 110 tons						1
Total		4				83
Net tonnage		52				2,665
Sail—						
5 to 10 tons		1				1
11 to 20 tons		1				1
31 to 40 tons						3
51 to 60 tons						3
61 to 70 tons						3
131 to 140 tons						1
141 to 150 tons						1
Total		2				13
Net tonnage		25				781
Total vessels		6				96
Total net tonnage		77				3,446
Boats:						
Motor	2	97	27	52	12	1,960
Other	15	170	41		22	2,856
Apparatus:						
Number	15	247	57	52		

Fisheries of the west coast of Florida, 1928—Continued

CATCH: BY GEAR

Species	Purse seines, menhaden		Haul seines, common		Gill nets			
					Drift		Set	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Amberjack					500	$15		
Black bass					2,200	220		
Bluefish			164,503	$9,208	195,690	15,306		
Blue runner or hardtail			161,362	3,716	70,205	2,215		
Bonito			1,480	37	200	8		
Cabio or crab eater			267	8				
Catfish and bullheads			1,400	56	4,273	191		
Cigarfish			116,500	3,215				
Crevalle			24,320	812	40,210	1,382		
Croakers			12,660	434	16,002	621		
Drum, black			11,948	334	14,713	454		
Drum, red, or redfish			139,232	5,038	404,771	15,974		
Flounders			12,379	540	24,540	1,049		
Groupers			800	32				
Kingfish or "king mackerel"			52,730	2,217	48,900	2,710		
King whiting or "kingfish"			22,805	840	30,259	1,080		
Ladyfish			356,342	9,416	2,547	77		
Menhaden	5,660,000	$34,724	197,000	4,425				
Mojarro			35,200	1,128	137,060	4,362		
Moonfish			701	21				
Mullet			4,415,766	194,434	16,807,309	706,613		
Permit			5,750	196	23,163	761		
Pigfish			12,830	463	35,874	1,314		
Pinfish or sailors choice			5,050	192	15,411	598		
Pompano			76,441	16,040	44,521	8,644		
Sawfish							45,000	$375
Sharks							226,500	2,552
Sheepshead, salt-water			81,953	3,069	201,813	7,836		
Snapper, mangrove			18,529	720	109,500	4,326		
Snook or sergeantfish			147,400	5,064	160,403	5,580		
Spadefish			16,295	512	35,504	1,262		
Spanish mackerel			815,135	62,595	2,158,649	135,130		
Spot			28,561	910	62,729	2,389		
Squeteagues or "sea trout"			389,399	33,545	1,016,923	94,680		
Sturgeon					16,247	2,097		
Yellowtail			7,900	316	27,058	1,262		
Turtles			886	9	6,849	547	15,000	1,200
Total	5,660,000	34,724	7,333,524	359,542	21,714,023	1,018,703	286,500	4,127

Species	Trammel nets		Lines						Pound nets	
			Hand		Trot with hooks		Troll			
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Amberjack			16,842	$569						
Barracuda							4,000	$120		
Bluefish	9,200	$840					3,400	400	17,477	$1,748
Blue runner or hardtail	230	5					750	15	179,345	5,380
Bonito	560	22							5,408	216
Butterfish									20,702	828
Cabio or crab eater			10,954	353					6,456	258
Catfish and bullheads	3,000	150			34,682	$1,387				
Cero							12,000	530		
Crevalle	3,080	98					650	19	238	9
Croakers	11,186	470							356	14
Dolphin									139	14
Drum, black	3,940	123	6,314	204					406	8
Drum, red, or redfish	38,097	1,740	238,046	8,689					13,792	688
Flounders	6,406	328	4,900	156					207	10
Groupers			3,970,449	121,921					92	6
Grunts			35,885	1,213						
Hogfish			1,500	45						
Jewfish			49,057	1,849					420	4
Kingfish or "king mackerel"	4,000	200	112,981	6,071			1,061,467	56,341	22,833	1,141
King whiting or "kingfish"	8,100	319								
Mullet	1,553,065	69,924							18,122	906
Muttonfish			34,600	3,460						
Permit			750	15						
Pigfish	2,800	96							240	7

Fisheries of the west coast of Florida, 1928—Continued

CATCH: BY GEAR—Continued

Species	Trammel nets		Lines						Pound nets	
			Hand		Trout with hooks		Troll			
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Pinfish or sailors choice	500	$15	300	$9						
Pompano	250, 328	49, 510	700	140					11, 476	$2, 869
Porgies			97, 324	2, 955						
Porkfish			600	18						
Sea bass			15, 560	1, 156						
Sheepshead, salt-water	34, 305	1, 557	133, 220	4, 803					2, 863	143
Snapper, mangrove	4, 600	230	26, 400	1, 046					632	32
Snapper, red			7, 891, 203	638, 227						
Snook or sergeantfish			10, 500	400						
Spadefish	3, 260	130	150	4					5, 661	226
Spanish mackerel	5, 900	550	31, 600	2, 206			163, 000	$8, 150	53, 533	5, 353
Spot	9, 915	413								
Squeteagues or "sea trout"	209, 713	20, 403	824, 343	73, 389					96, 431	9, 643
Tang			150	4						
Tripletail			7, 000	500						
Turbot			200	6						
Yellowtail			81, 200	7, 298						
Total	2, 162, 185	147, 123	13, 602, 728	876, 706	34, 682	$1, 387	1, 245, 267	65, 575	456, 829	29, 503

Species	Stop nets		Fyke nets		Dip nets		Cast nets	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Blue runner or hardtail	7, 000	$210						
Bonito	1, 388	41						
Catfish and bullheads			55, 650	$1, 670				
Crevalle	8, 000	240						
Croaker	1, 800	54						
Drum, black	2, 000	60						
Drum, red, or redfish	55, 000	1, 750					400	$24
Flounders	4, 685	145						
King whiting or "kingfish"	9, 000	270						
Mojarro	53, 000	1, 590						
Mullet	680, 000	25, 200					15, 000	840
Permit	3, 800	114						
Pigfish	3, 400	102						
Pinfish or sailors choice	1, 610	48						
Pompano	35, 600	6, 520						
Sheepshead, salt-water	44, 768	1, 531					400	24
Snapper, mangrove	26, 000	980						
Snook or sergeantfish	52, 184	1, 565						
Spadefish	5, 571	167						
Spot	7, 000	210						
Squeteague or "sea trout"	144, 443	12, 144					1, 200	120
Yellowtail	6, 000	240						
Crabs, hard					2, 400	$180		
Crabs, stone					380	38		
Sea crawfish or spiny lobster					113, 803	8, 704		
Total	1, 152, 249	53, 181	55, 650	1, 670	116, 583	8, 922	17, 000	1, 008

Species	Otter trawls, shrimp		Crab pots		Crawfish pots		Spears		Dredges	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Flounders							45, 925	$3, 707		
Crabs, hard			4, 500	$551						
Crabs, stone			73, 780	11, 460						
Sea crawfish or spiny lobster					25, 352	$2, 028				
Shrimp	2, 877, 174	$115, 486								
Clams, hard									687, 520	$42, 970
Total	2, 877, 174	115, 486	78, 280	12, 011	25, 352	2, 028	45, 925	3, 707	687, 520	42, 970

Fisheries of the west coast of Florida, 1928—Continued

CATCH: BY GEAR—Continued

Species	Tongs		Rakes		Forks		Sponge hooks	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Clams, hard					28, 352	$1, 774		
Oysters, market, public	2, 821, 476	$212, 122	35, 000	$6, 250				
Oysters, market, private	2, 100	300						
Sponges:								
Grass							53, 939	$12, 3[illegible]1
Sheepswool							94, 627	136, 505
Wire							1, 269	677
Yellow							26, 312	9, 956
Total	2, 823, 576	212, 422	35, 000	6, 250	28, 352	1, 774	176, 147	159, 529

Species	Sea crawfish hooks		Diving outfits		By hand	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Crabs, stone	2, 780	$338				
Sea crawfish or spiny lobster	57, 901	4, 422				
Clams, hard					34, 856	$4, 249
Scallops, bay					14, 100	5, 000
Scallops, sea					2, 100	1, 050
Terrapin					461	115
Sponges:						
Grass			54, 937	$15, 383		
Sheepswool			250, 959	641, 992		
Wire			11, 421	6, 091		
Yellow			60, 894	28, 367		
Conchs	15, 600	1, 123				
Total	76, 281	5, 883	378, 211	691, 833	51, 517	10, 414

OPERATING UNITS: BY COUNTIES

Items	Bay	Charlotte	Citrus	Collier	Dixie	Escambia	Franklin	Gulf
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	165					337	34	60
On boats and shore—								
Regular	303	468	240	120	30	185	724	49
Casual	6	70		20		8	1	
Total	474	538	240	140	30	530	759	109
Vessels:								
Motor—								
5 to 10 tons	5						8	
11 to 20 tons	6					7	1	
21 to 30 tons	3					1		
31 to 40 tons	1							1
41 to 50 tons	2					6		
51 to 60 tons						4		
61 to 70 tons	5					7		1
71 to 80 tons						2		
91 to 100 tons						1		
101 to 110 tons						1		
Total	22					29	9	2
Net tonnage	652					1, 422	65	96
Sail—								
31 to 40 tons						2		
51 to 60 tons						3		
61 to 70 tons						3		
131 to 140 tons						1		
141 to 150 tons						1		
Total						10		
Net tonnage						717		
Total vessels	22					39	9	2
Total net tonnage	652					2, 139	65	96
Boats:								
Motor	90	269	103	43	6	51	447	12
Other	84	369	203	99	30	48	325	16

Fisheries of the west coast of Florida, 1928—Continued

OPERATING UNITS: BY COUNTIES—Continued

Items	Bay	Charlotte	Citrus	Collier	Dixie	Escambia	Franklin	Gulf
Apparatus:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Purse seines, menhaden								2
Yards								560
Haul seines, common	29	23		1		4	15	5
Yards	9,290	9,450		400		1,450	6,050	2,200
Gill nets—								
Drift	42	293	170	60	21	19	44	3
Square yards	23,120	460,814	102,000	69,470	8,400	22,700	21,700	1,800
Trammel nets	15	38		2		33		4
Square yards	9,000	92,950		2,100		15,400		1,460
Lines—								
Hand	233	168	41	40	19	410	156	
Hooks	466	168	41	40	19	820	197	
Stop nets		230						
Square yards		38,250						
Fyke nets							240	
Dip nets, common						6		
Cast nets	12							
Otter trawls, shrimp						8	114	
Yards at mouth						80	1,295	
Spears	28						22	
Dredges, clam				2				
Tongs	72	6	29			32	384	
Forks				15				

Items	Hernando	Hillsborough	Jefferson	Lee	Levy	Manatee	Monroe	Okaloosa
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels		25					50	
On boats and shore—								
Regular	4	140	12	190	196	161	434	112
Casual					10	10		
Total	4	165	12	190	206	171	484	112
Vessels:								
Motor—								
5 to 10 tons							2	
11 to 20 tons		3					3	
21 to 30 tons		1						
51 to 60 tons							2	
Total		4					7	
Net tonnage		63					172	
Total vessels		4					7	
Total net tonnage		63					172	
Boats:								
Motor	1	49	3	123	85	55	152	20
Other	4	104	12	154	165	130	245	12
Apparatus:								
Haul seines, common		11		3		17		14
Yards		4,100		1,300		7,300		4,900
Gill nets—								
Drift	4	97	12	146	114	134	53	
Square yards	2,400	55,950	7,200	175,862	42,630	156,965	145,600	
Set							12	
Square yards							5,100	
Trammel nets				4	100	8		12
Square yards				10,200	36,300	8,400		5,450
Lines—								
Hand		55	10	53	55	34	108	42
Hooks		96	10	53	55	34	151	84
Trot with hooks					6			
Hooks					1,000			
Troll					6		136	
Hooks					12		272	
Pound nets					10			
Stop nets				10				
Square yards				1,500				
Dip nets, common							51	
Cast nets						3		

Fisheries of the west coast of Florida, 1928—Continued

OPERATING UNITS: BY COUNTIES—Continued

Items	Hernando	Hillsborough	Jefferson	Lee	Levy	Manatee	Monroe	Okaloosa
Apparatus—Continued.								
Pots—	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Crab							120	
Crawfish							330	
Spears								8
Tongs					20	8		
Hooks—								
Sponge							186	
Sea crawfish							55	

Items	Pasco	Pinellas	Santa Rosa	Sarasota	Taylor	Wakulla	Walton
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels		93					
On boats and shore—							
Regular	29	940	30	162	55	196	10
Casual		103	4			10	
Total	29	1,136	34	162	55	206	10
Vessels:							
Motor—							
5 to 10 tons		2					
11 to 20 tons		4					
21 to 30 tons		2					
31 to 40 tons		2					
Total		10					
Net tonnage		195					
Sail—							
5 to 10 tons		1					
11 to 20 tons		1					
31 to 40 tons		1					
Total		3					
Net tonnage		64					
Total vessels		13					
Total net tonnage		259					
Boats:							
Motor	5	247	9	150	11	26	3
Other	29	336	12	254	55	165	5
Apparatus:							
Haul seines, common		18		14		10	
Yards		10,350		4,625		2,450	
Gill nets—							
Drift	29	291		132	49	140	
Square yards	17,400	295,525		123,300	24,000	84,000	
Trammel nets		9	12	12			5
Square yards		14,700	5,400	12,600			1,500
Lines—							
Hand		224		56	12		
Hooks		322		74	12		
Troll				174	10		
Hooks				174	20		
Pots—Crab		1,265		125			
Spears			8				
Tongs		1	6			20	
Rakes				18			
Hooks—							
Sponge		61					
Sea crawfish		2					
Diving apparatus		52					

Fisheries of the west coast of Florida, 1928—Continued

CATCH: BY COUNTIES

Species	Bay		Charlotte		Citrus		Collier	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Amberjack	942	$28						
Black bass					2,200	$220		
Bluefish	108,244	5,413	59,371	$4,913	13,592	1,359	2,600	$148
Blue runner or hardtail	29,029	846	11,115	333			8,240	300
Bonito	700	21	1,388	41				
Cabio or crab eater			5,554	167				
Cigarfish	88,500	2,655						
Crevalle			18,912	567	1,232	37	6,500	235
Croakers			4,881	156			850	25
Drum, black			4,356	130	2,118	63	3,000	98
Drum, red, or redfish	8,990	386	337,711	10,510	54,320	2,476	38,500	1,540
Flounders	19,016	1,721	15,463	480	1,556	71	550	22
Groupers	987,032	29,615	3,278	98	2,000	80	2,000	80
Grunts			3,996	120	1,800	80	2,000	80
Jewfish	9,200	276	4,248	123			1,000	20
Kingfish or "king mackerel"	1,661	66	61,839	3,092			3,400	180
King whiting or "kingfish"	400	16	17,567	527			6,900	276
Ladyfish	176,067	5,281						
Menhaden	30,500	915						
Mojarro			162,099	4,863			11,000	340
Moonfish	701	21						
Mullet	974,369	50,283	4,491,805	172,373	1,699,048	78,122	689,848	27,594
Permit			16,671	500			4,000	150
Pigfish			7,659	240	1,880	84	2,500	85
Pinfish or sailors choice			3,587	107			650	25
Pompano	13,665	2,783	179,577	32,581	1,190	238	2,639	528
Porgies	36,183	1,086						
Sea bass					800	80		
Sheepshead, salt-water	22,640	1,036	183,476	5,892	20,306	905	14,000	560
Snapper, mangrove	811	32	62,832	2,306	18,168	758	4,600	184
Snapper, red	1,435,063	114,717						
Snook or sergeantfish			203,400	6,101			41,393	1,656
Spadefish	1,376	41	15,989	479	2,960	136	1,900	67
Spanish mackerel	345,704	27,655	495,966	29,758			16,778	1,148
Spot	16,715	501	13,971	419			2,000	70
Squeteague or "sea trout"	100,624	8,751	604,770	50,070	228,752	22,875	73,646	6,415
Tripletail			3,000	220			1,000	60
Yellowtail			14,000	560			2,000	120
Clams, hard							715,872	44,744
Oysters, market, public	90,468	12,924	14,000	2,000	199,500	9,650		
Total	4,498,600	267,069	7,022,481	329,726	2,251,422	117,234	1,659,366	86,750

Species	Dixie		Escambia		Franklin		Gulf		Hernando	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Amberjack			400	$16						
Bluefish	3,000	$270	65,517	3,603	3,673	$200	10,540	$527	300	$36
Blue runner or hardtail			57,827	1,156	600	12	2,230	45		
Bonito			780	16						
Cabio or crab eater			1,500	45						
Catfish and bullheads					59,323	1,817				
Crevalle			1,040	32						
Croakers	400	16	4,860	146	800	24	566	11		
Drum, black			685	9	699	28			100	5
Drum, red, or redfish	14,000	560	22,367	671	12,732	636	2,244	89	800	64
Flounders	600	24	2,112	127	20,983	1,138	1,000	60	100	8
Groupers			1,493,351	44,814	366,162	10,885				
Grunts	1,000	40			200	6				
Jewfish			13,300	399						
Kingfish or "king mackerel"			19,855	794			1,000	40		
King whiting or "kingfish"			15,280	611	1,500	45	1,000	30		
Ladyfish			58,450	1,169	59,441	1,633	10,000	300		
Menhaden			128,500	2,570	18,000	540	5,660,000	34,724		
Mullet	200,000	8,000	348,221	13,929	1,324,688	57,446	177,750	7,510	60,000	3,600
Pigfish	3,000	120	2,830	85					100	6
Pinfish or sailors choice	2,000	80					500	15		
Pompano	1,800	270	12,112	2,907	2,334	671	10,000	2,500	100	30
Porgies			22,865	687	800	24				
Sheepshead, salt-water	12,000	480	14,911	596	3,766	163	1,678	67	300	24
Snapper, mangrove	2,000	80							300	18
Snapper, red			4,618,581	372,953	577,732	50,596				
Spadefish	100	4	1,340	54	1,500	45	1,180	23	100	6
Spanish mackerel	100	8	236,522	21,287	28,464	2,277	56,400	4,512		

Fisheries of the west coast of Florida, 1928—Continued

CATCH: BY COUNTIES—Continued

Species	Dixie		Escambia		Franklin		Gulf		Hernando	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Spot	4,000	$160	1,280	$26	232	$4				
Squeteague or "sea trout"	40,000	3,600	8,000	720	83,101	7,791	18,500	$1,480	4,000	$480
Sturgeon			3,604	432	9,599	1,056				
Crabs, hard			2,400	180						
Shrimp			87,072	3,483	2,790,102	112,003				
Oysters, market, public			100,800	14,400	2,315,208	165,618				
Turtles			886	9						
Total	284,000	13,712	7,347,248	487,926	7,681,639	414,658	5,954,588	51,933	66,200	4,277

Species	Hillsborough		Jefferson		Lee		Levy		Manatee	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bluefish	96	$12	360	$32	9,254	$1,065	25,577	$2,558	20,444	$1,635
Blue runner or hardtail	250	10			10,392	340	179,345	5,380	12,300	492
Bonito							6,168	246		
Butterfish							20,702	828		
Cabio or crab eater	767	23					6,456	258	2,400	96
Catfish and bullheads							39,682	1,637		
Crevalle	8,923	262			7,832	256	1,338	53	9,893	396
Croakers	1,000	32	200	8	2,470	80	6,956	328	2,845	114
Dolphin							139	14		
Drum, black	6,207	132			4,316	130	4,519	90	3,500	140
Drum, red, or redfish	57,121	2,316	15,612	624	35,284	1,127	53,521	2,674	74,130	2,965
Flounders	2,215	92	50	2	2,340	75	2,857	143	8,925	357
Groupers	143,183	4,296			7,031	224	10,092	406	6,000	240
Grunts					4,080	127			3,000	120
Jewfish	416	12			2,400	52	420	4	800	16
Kingfish or "king mackerel"					13,026	781	34,859	1,742	25,756	1,595
King whiting or "kingfish"	625	20			10,560	347			4,580	183
Ladyfish	7,071	71							3,000	60
Mojarro	5,250	210			31,751	1,061			10,150	406
Mullet	1,364,734	60,496	122,640	4,906	1,982,464	79,298	1,126,832	55,842	1,742,163	68,686
Permit	250	10			6,990	223			1,025	41
Pigfish	5,250	160	400	16	8,712	273	1,840	75	11,137	445
Pinfish or sailors choice	1,800	72	150	6	1,660	52			2,625	105
Pompano	5,120	1,024	100	15	5,875	1,180	18,362	4,592	64,650	12,930
Porgies	100	3							1,000	40
Sea bass							14,760	1,076		
Sheepshead, salt-water	8,712	348	11,250	450	40,507	1,336	28,503	1,425	31,300	1,252
Snapper, mangrove	1,150	46	2,400	96	15,904	505	8,632	432	10,660	426
Snapper, red	156,557	12,525								
Snook or sergeantfish	17,375	785			34,265	1,105			32,360	1,294
Spadefish	7,973	210			4,571	145	12,161	486	5,635	226
Spanish mackerel	10,350	812	100	8	145,380	8,723	59,433	5,943	177,425	13,739
Spot	6,700	208	4,400	176	9,175	290	10,000	500	9,460	378
Squeteague or "sea trout"	176,548	15,839	19,250	1,732	173,460	14,583	437,675	43,767	159,945	13,565
Sturgeon							3,044	609		
Tripletail					3,000	220				
Yellowtail					5,860	234				
Clams, hard					1,000	140			1,856	209
Oysters, market, public							43,400	2,860	6,300	990
Terrapin							461	115		
Turtles							6,849	547		
Total	1,995,743	100,026	176,912	8,071	2,579,559	113,972	2,164,583	134,630	2,445,264	123,141

Species	Monroe		Okaloosa		Pasco		Pinellas	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Amberjack	9,200	$276	800	$24			6,000	$240
Barracuda	4,000	120						
Bluefish	12,400	1,480	20,542	1,130	2,300	$230	19,300	1,805
Blue runner or hardtail	16,750	335	65,006	1,300			3,760	114
Cero	12,000	530						
Cigarfish			28,000	560				
Crevalle	1,450	43	4,600	138			3,270	81
Croakers			2,400	72			1,404	56

Fisheries of the west coast of Florida, 1928—Continued

CATCH: BY COUNTIES—Continued

Species	Monroe		Okaloosa		Pasco		Pinellas	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Drum, black	800	$24	400	$6	400	$16	1,950	$47
Drum, red, or redfish	1,600	48	3,404	102	10,000	400	37,537	1,607
Flounders			4,139	378	400	16	5,932	263
Groupers	235,800	9,427	224,708	6,741			478,576	14,689
Grunts	12,200	366					5,609	214
Hogfish	1,500	45						
Jewfish	14,100	843	3,093	93			500	15
Kingfish or "king mackerel"	901,487	44,954	27,975	1,119			59,099	3,281
King whiting or "kingfish"	1,600	48	800	32			2,480	99
Ladyfish			40,754	815			4,106	164
Menhaden			20,000	400				
Mojarro							2,010	80
Mullet	190,615	5,718	216,186	8,648	365,636	14,625	3,105,414	124,215
Muttonfish	34,600	3,460						
Permit	1,150	27					500	20
Pigfish							4,780	191
Pinfish or sailors choice	1,100	33			1,500	60	4,545	182
Pompano	1,800	360	10,198	2,448	400	88	37,614	7,087
Porgies	4,500	135	28,476	854			2,400	96
Porkfish	600	18						
Sawfish	45,000	375						
Sharks	226,500	2,552						
Sheepshead, salt-water	3,100	94	5,840	234	10,000	400	36,185	1,576
Snapper, mangrove	19,000	760			10,000	400	8,050	352
Snapper, red	208,200	19,620	132,409	10,592			762,661	57,224
Snook or sergeantfish							7,170	287
Spadefish	550	16	665	20	400	16	2,400	96
Spanish mackerel	1,058,000	52,900	140,243	11,219			343,579	24,935
Spot	800	24	2,440	73			4,698	178
Squeteague or "sea trout"	400	40	19,460	1,946	16,000	1,600	283,620	25,608
Tang	150	4						
Turbot	200	6						
Yellowtail	83,200	7,518						
Crabs, stone	10,760	876					64,560	10,510
Sea crawfish or spiny lobster	197,056	15,154						
Clams, hard							8,000	1,200
Oysters, market, private							2,100	300
Scallops, bay							14,100	5,000
Turtles	15,000	1,200						
Sponges:								
Grass	29,387	3,469					79,489	24,305
Sheepswool	34,844	52,265					310,742	726,232
Wire							12,690	6,768
Yellow	19,287	6,429					67,919	31,894
Conchs	15,600	1,123						
Total	3,426,286	232,715	1,002,538	48,944	417,036	17,851	5,794,749	1,071,016

Species	Santa Rosa		Sarasota		Taylor		Wakulla		Walton	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bluefish			8,000	$800	700	$63	4,460	$223		
Blue runner or hardtail			21,098	844	100	4	850	30		
Cabio or crab eater			1,000	30						
Crevalle			11,508	460						
Croakers	3,000	$150	7,672	307	700	28			1,000	$40
Drum, black	1,200	60	2,877	114			1,794	71	400	20
Drum, red, or redfish	1,800	180	30,588	1,223	14,820	593	61,257	3,062	1,000	50
Flounders	8,400	840	1,438	57	110	4	656	32	200	20
Groupers			12,128	364						
Grunts			2,000	60						
Kingfish or "king mackerel"			122,954	9,836	30,000	1,200				
King whiting or "kingfish"			6,672	267					200	8
Mojarro			3,000	120						
Mullet	182,800	9,140	1,028,221	46,270	282,620	11,305	1,738,208	86,911	75,000	3,000
Permit			2,877	115						
Pigfish			4,356	174	700	28				
Pinfish or sailors choice			959	38	300	12	1,495	75		
Pompano			49,096	11,047	360	54	1,674	290	400	100
Porgies			1,000	30						
Sheepshead, salt-water	2,400	120	31,086	1,243	10,400	416	5,962	296	1,000	50
Snapper, mangrove			5,754	229	6,000	240	9,400	470		
Snook or sergeantfish			34,524	1,381						
Spadefish			4,795	191	150	6	696	34		
Spanish mackerel			112,577	9,006	260	21	536	33		
Spot			3,918	156	3,640	136	14,576	617	200	6

Fisheries of the west coast of Florida, 1928—Continued

CATCH: BY COUNTIES—Continued

Species	Santa Rosa		Sarasota		Taylor		Wakulla		Walton	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Squeteague or "sea trout"	1,000	$100	77,490	$7,749	40,700	$3,663	105,511	$10,550	10,000	$1,000
Yellowtail			17,098	684						
Crabs, hard			4,500	551						
Crabs, stone			1,620	450						
Clams, hard			24,000	2,700						
Oysters, market, public	8,400	1,200	35,000	6,250			43,400	2,480		
Scallops, sea			2,100	1,050						
Total	209,000	11,790	1,671,906	103,796	391,560	17,773	1,990,475	105,174	89,400	4,294

INDUSTRIES RELATED TO THE FISHERIES

Transporting trade.—There were 47 persons in 1928 engaged on the west coast of Florida primarily in transporting the catch from the fishing grounds to market. In this trade 19 motor vessels, having a total capacity of 295 net tons, were operated. The size of vessel in most popular use ranged fron 11 to 20 net tons.

Wholesale trade.—There were 110 wholesale establishments along the west coast of Florida engaged chiefly in handling fresh and frozen products. This is 44 per cent of the total number of such establishments in the Gulf section. Virtually the entire catch of fishery products taken along the west coast of Florida consisted of market fish which accounts for the large percentage of wholesale fish establishments located there. These establishments employed 667 persons who received $528,088 in salaries and wages. Pinelles County had 26 wholesale establishments. Other counties of importance were Monroe and Bay, each with 11 establishments.

Prepared and by-products trade.—There were 10 establishments along the west coast of Florida in 1928 engaged primarily in the manufacture of prepared fishery products or by-products. This is 10 per cent of the total number in the Gulf section. They employed 232 persons who received $147,021 in salaries and wages. The products manufactured consisting principally of menhaden products and canned shrimp and clam products were valued at $683,610. Detailed statistics of most of the items manufactured may be obtained from Fishery Industries of the United States, 1928, Bureau of Fisheries Document No. 1067.

In addition to the above, 428,554 pounds of salted mullet and mullet roe, valued at $25,467, were prepared by the fishermen.

Industries related to the fisheries of the west coast of Florida, 1928

TRANSPORTING

Items	Number
Men on transporting vessels	47
Transporting vessels, motor:	
5 to 10 tons	6
11 to 20 tons	10
21 to 30 tons	1
31 to 40 tons	2
Total vessels	19
Total net tonnage	295

Industries related to the fisheries of the west coast of Florida, 1928—Continued

WHOLESALE FISHERY TRADE

Items	Bay County	Charlotte County	Citrus and Pasco Counties	Escambia, Okaloosa, and Santa Rosa Counties	Franklin and Gulf Counties	Hillsborough County
Establishments	11	5	8	5	14	11
Persons engaged:						
Proprietors	12	7	8	7	15	14
Salaried employees	5	5	1	19	3	4
Wage earners	23	36	21	61	65	27
Paid to salaried employees	$20,865	$18,744	$3,220	$57,690	$7,696	$15,880
Paid to wage earners	18,743	27,854	13,512	69,299	33,340	21,550
Total salaries and wages	39,608	46,598	16,732	126,989	41,036	37,430

Items	Lee and Collier Counties	Levy and Wakulla Counties	Manatee and Sarasota Counties	Monroe County	Pinellas County	Total
Establishments	3	7	9	11	26	110
Persons engaged:						
Proprietors	4	11	16	13	31	138
Salaried employees	3	3	3	3	8	57
Wage earners	7	25	15	42	150	472
Paid to salaried employees	$13,500	$6,219	$14,061	$14,090	$28,504	$200,469
Paid to wage earners	5,346	19,470	14,940	33,587	69,978	327,619
Total salaries and wages	18,846	25,689	29,001	47,677	98,482	528,088

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS

Items	Number	Products	Quantity	Value
Establishments	10	Salted:		
Persons engaged:		Mullet ... pounds	450,376	$34,919
Proprietors	12	Mullet roe ... do	38,770	11,530
Salaried employees	15	Canned:		
Wage earners	205	Oysters ... standard cases [1]	10,084	52,968
		Shrimp—		
Paid to salaried employees	$50,261	Dry pack ... do	3,685	22,560
Paid to wage earners	96,760	Wet pack ... do	27,447	191,634
		Miscellaneous products [2]		369,999
Total salaries and wages	147,021			
		Total		683,610

PRODUCTS PREPARED BY THE FISHERMEN

Salted	Pounds	Value
Mullet	402,543	$20,265
Mullet roe	26,011	5,202
Total	428,554	25,467

[1] A standard case contains forty-eight 5-ounce cans of oysters; forty-eight 5-ounce cans in the dry pack, or forty-eight 5¾-ounce cans in the wet pack of shrimp.
[2] Includes canned turtle and canned clam products, shark and sawfish products, menhaden products, yster-shell products, and salted fish other than mullet and mullet roe.

ALABAMA

The fisheries of Alabama in 1928 employed 5 per cent of the total number of fishermen and accounted for 8 per cent of the total catch of the Gulf section. The fisheries and industries related to the fisheries employed 1,224 persons, which is 9 per cent greater than the number in 1927. Of the total, 858 were fishermen, 6 were employed on transporting vessels, 143 in the wholesale trade, and 217 in the prepared-products and by-products industries.

The total catch amounted to 14,466,480 pounds, valued at $586,795. This is an increase of 44 per cent in the catch and 34 per cent in the value of the catch, compared with the catch and its value for 1927. Of the total value of the catch, that for shrimp accounted for 31 per cent; oysters, 26 per cent; red snapper, 20 per cent; and mullet, 14 per cent. Of the total production, that of shrimp accounted for 41 per cent; oysters, 29 per cent; mullet, 15 per cent; and red snapper, 9 per cent.

OPERATING UNITS BY GEAR

The catch of fishery products along the coast of Alabama during 1928 was taken by 858 fishermen who used 44 motor vessels, 531 motor and other boats, and 8 major types of gear. The vessels had a combined capacity of 487 net tons. The fisheries accounting for the greatest number of persons were the otter-trawl fishery, employing 360 fishermen, and the tong fishery, employing 247 fishermen.

CATCH BY GEAR

Four types of gear caught 93 per cent of the fish taken in the marine waters of Alabama during 1928. Listed in order of their importance they were otter trawls, which accounted for 41 per cent of the catch; tongs, 29 per cent; lines, 12 per cent; and trammel nets, 11 per cent.

The catch by otter trawl consisted almost entirely of shrimp; that by tongs almost entirely oysters; that by lines principally red snappers; and that by trammel nets chiefly mullet.

OPERATING UNITS BY COUNTIES

The fisheries of Alabama are confined to Baldwin and Mobile Counties. Mobile County accounted for 85 per cent of the number of persons fishing, 82 per cent of the fishing vessels, and 81 per cent of the small motor and other types of fishing boats.

CATCH BY COUNTIES

Of the two counties in Alabama in which marine fisheries were prosecuted, Mobile County was by far the most important, accounting for 89 per cent of the total catch and 86 per cent of the value of the catch. Baldwin County accounted for the remaining 11 per cent of the catch and 14 per cent of the value of the catch.

Fisheries of Alabama, 1928

OPERATING UNITS: BY GEAR

Items	Haul seines, common	Gill nets set	Trammel nets	Lines		
				Hand	Trot with hooks	Trot with baits or snoods
	Number	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:						
On vessels	18	2	34	110		
On boats and shore:						
Regular	33	2	95	50	2	17
Casual			8		38	
Total	51	4	137	160	40	17
Vessels:						
Motor—						
5 to 10 tons	3	1	6	3		
11 to 20 tons			1	8		
31 to 40 tons				1		
61 to 70 tons				1		
Total vessels	3	1	7	13		
Total net tonnage	24	7	57	232		
Boats:						
Motor	8	1	40	7	5	
Other	8	2	102	18	40	17
Apparatus:						
Number	15	32	136	160	118	17
Length, yards	5,200					
Square yards		5,400	40,800			
Hooks, baits, or snoods				302	11,500	4,400

Items	Fyke nets	Otter trawls, shrimp	Spears	Tongs	By hand	Total, exclusive of duplication
	Number	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:						
On vessels		50		12		202
On boats and shore:						
Regular		310	77	235	4	610
Casual	24					46
Total	24	360	77	247	4	858
Vessels:						
Motor—						
5 to 10 tons		20		4		30
11 to 20 tons		3				12
31 to 40 tons						1
61 to 70 tons						1
Total vessels		23		4		44
Total net tonnage		187		27		487
Boats:						
Motor	4	155		83		260
Other	24			117		271
Apparatus:						
Number	96	178	77	245		
Yards at mouth		2,268				

Fisheries of Alabama, 1928—Continued

CATCH: BY GEAR

Species	Haul seines, common		Gill nets, set		Trammel nets	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Angelfish	2,252	$88			938	$39
Bluefish	26,296	1,779			5,168	309
Blue runner or hardtail	12,385	494			9,695	388
Catfish and bullheads	2,233	126			6,939	300
Crevalle	1,300	39			4,500	134
Croaker	5,750	174			40,578	1,283
Drum, black	1,928	97			5,775	225
Drum, red, or redfish	20,856	1,666			28,551	2,292
Flounders	2,780	278			4,364	441
King whiting or "kingfish"					900	27
Mullet	761,374	30,453			1,356,967	54,425
Pompano	2,006	368			3,448	59[illegible]
Sheepshead, salt-water	12,647	1,002			24,731	1,99[illegible]
Snook or sergeantfish	22	2				
Spanish mackerel	4,339	403				
Spot	4,650	139			6,183	148
Squeteague or "sea trout"	24,941	2,597			86,317	8,709
Sturgeon			9,666	$2,100		
Total	885,759	39,705	9,666	2,100	1,585,054	71,310

Species	Lines						Fyke nets	
	Hand		Trot with hooks		Trot with baits or snoods			
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Black bass							1,067	$127
Buffalofish							37,686	1,507
Catfish and bullheads			81,885	$4,912			20,000	1,200
Groupers	198,501	$7,124						
Jewfish	3,400	121						
Paddlefish			2,641	158				
Pompano	60	15						
Sheepshead, salt-water	150	12						
Snapper, red	1,300,522	118,655						
Squeteague or "sea trout"	14,000	1,400						
Sunfish							1,725	69
Tripletail	1,600	160						
Crabs, hard					99,200	$4,160		
Total	1,518,233	127,487	84,526	5,070	99,200	4,160	60,478	2,903

Species	Otter trawls, shrimp		Spears		Tongs		By hand	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Flounders			26,687	$2,775				
Crabs, soft							3,200	$800
Crabs, hard	2,636	$66						
Shrimp	5,972,489	179,174						
Oysters, market, private					143,976	$10,284		
Oysters, market, public					4,074,147	140,823		
Terrapin					429	138		
Total	5,975,125	179,240	26,687	2,775	4,218,552	151,245	3,200	800

Fisheries of Alabama, 1928—Continued

OPERATING UNITS: BY COUNTIES

Items	Baldwin	Mobile	Items	Baldwin	Mobile
Fishermen:	*Number*	*Number*	Apparatus:	*Number*	*Number*
On vessels	30	172	Haul seines, common	2	13
On boats or shore—			Length, yards	750	4,450
Regular	102	508	Gill nets, set	20	12
Casual		46	Square yards	3,000	2,400
			Trammel nets	64	72
Total	132	726	Square yards	19,200	21,600
Vessels:			Lines—		
Motor—			Hand		160
5 to 10 tons	6	24	Hooks		302
11 to 20 tons	2	10	Trot with hooks	6	112
31 to 40 tons		1	Hooks	500	11,000
61 to 70 tons		1	Trot with baits or snoods	10	7
			Baits or snoods	3,000	1,400
Total vessels	8	36	Fyke nets		96
Total net tonnage	72	415	Otter trawls, shrimp	14	164
			Yards at mouth	184	2,084
Boats:			Spears	16	61
Motor	32	228	Tongs	38	207
Other	67	204			

CATCH: BY COUNTIES

Species	Baldwin		Mobile	
	Pounds	*Value*	*Pounds*	*Value*
Angelfish	1,222	$48	1,968	$79
Black bass			1,067	127
Bluefish	4,365	261	27,099	1,827
Blue runner or hardtail	3,312	132	18,768	750
Buffalofish			37,686	1,507
Catfish and bullheads	5,834	306	105,223	6,232
Crevalle	920	27	4,880	146
Croaker	22,517	682	23,811	775
Drum, black	3,189	122	4,514	200
Drum, red, or redfish	20,517	1,661	28,890	2,297
Flounders	9,186	1,029	24,645	2,465
Groupers			198,501	7,124
Jewfish			3,400	121
King whiting or "kingfish"	400	12	500	15
Mullet	661,057	26,590	1,457,284	58,288
Paddlefish			2,641	158
Pompano	4,280	675	1,234	306
Sheepshead, salt-water	25,612	2,054	11,916	952
Snapper, red			1,300,522	118,655
Snook or sergeantfish			22	2
Spanish mackerel	2,400	192	1,939	211
Spot	6,009	180	4,824	107
Squeteague or "sea trout"	33,855	3,463	91,403	9,243
Sturgeon	5,666	1,700	4,000	400
Sunfish			1,725	69
Tripletail			1,600	160
Crabs, soft			3,200	800
Crabs, hard	32,000	2,000	69,836	2,226
Shrimp	478,711	14,362	5,493,778	164,812
Oysters, market, private			143,976	10,284
Oysters, market, public	328,933	26,290	3,745,224	114,533
Terrapin	342	114	87	24
Total	1,650,317	81,900	12,816,163	504,895

INDUSTRIES RELATED TO THE FISHERIES

Transporting trade.—In 1928 there were six persons in Alabama engaged in transporting the catch of fishery products. In this trade, two motor vessels having a total capacity of 32 net tons, and one sailing vessel having a capacity of 7 net tons were operated.

Wholesale trade.—There were 17 wholesale establishments in Alabama engaged chiefly in handling fresh and frozen fishery products. This is 7 per cent of the total number of such establishments in the Gulf section. These employed 143 persons, who received $167,110 in salaries and wages. All of these establishments were located in Mobile County.

Prepared and by-products trade.—There were seven establishments in Alabama in 1928 engaged primarily in the manufacture of prepared fishery products or by-products. This is 7 per cent of the total number in the Gulf section. They employed 217 persons, who received $149,807 in salaries and wages. The products manufactured, consisting principally of canned shrimp and oysters, were valued at $640,772. Detailed statistics of most of the items manufactured may be obtained from Fishery Industries of the United States, 1928, Bureau of Fisheries Document No. 1067.

In addition to the above, 8,866 pounds of fishery products, valued at $720, were prepared by the fishermen. These consisted mostly of salted mullet and mullet roe.

Industries related to the fisheries of Alabama, 1928

TRANSPORTING

Items	Number	Items	Number
Men on transporting vessels	6	Transporting vessels—Continued	
Transporting vessels:		Sail	1
Motor—		Net tonnage	7
11 to 20 tons	2	Total vessels	3
Net tonnage	32	Total net tonnage	39

WHOLESALE FISHERY TRADE

Items	Mobile County	Items	Mobile County
Establishments	17	Paid to salaried employees	$97,554
Persons engaged:		Paid to wage earners	69,556
Proprietors	23		
Salaried employees	14	Total salaries and wages	167,110
Wage earners	106		

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS

Items	Number	Products [1]	Quantity	Value
Establishments	7	Salted mullet ... pounds	222,000	$16,940
Persons engaged:		Canned:		
Proprietors	10	Oysters ... standard cases [2]	32,978	176,330
Salaried employees	12	Shrimp—		
Wage earners	195	Dry pack ... do	51,911	311,267
		Wet pack ... do	15,117	89,811
Paid to salaried employees	$32,680	Oyster shell products ... tons	6,028	43,149
Paid to wage earners	117,127	Other products [3] ... pounds	11,300	3,275
Total salaries and wages	149,807	Total		640,772

PRODUCTS PREPARED BY THE FISHERMEN

Items	Pounds	Value
Fresh sturgeon roe	266	$200
Salted:		
Mullet	8,000	400
Mullet roe	600	120
Total	8,866	720

[1] Includes a small amount of salted and packaged products prepared by 4 firms whose activities were principally in the wholesale fishery trade.
[2] A standard case contains forty-eight 5-ounce cans of oysters, forty-eight 5-ounce cans in the dry pack, or forty-eight 5¾-ounce cans in the wet pack of shrimp.
[3] Includes salted mullet roe and packaged grouper tenderloins.

MISSISSIPPI

The fisheries of Mississippi in 1928 employed 13 per cent of the total number of fishermen and accounted for 16 per cent of the total catch of the Gulf section. The fisheries and industries related to the fisheries employed 3,231 persons, which is 14 per cent less than the number in 1927. Of the total, 2,203 were fishermen, 4 were employed on transporting vessels, 233 in the wholesale trade, and 791 in the prepared-products and by-products industries.

The total catch amounted to 30,700,669 pounds, valued at $1,060,066. This is a decrease of 11 per cent in the catch and 16 per cent in the value of the catch, compared with the catch and its value for 1927. Of the total value of the catch, that for oysters accounted for 47 per cent; shrimp, 36 per cent; crabs, 5 per cent; and squeteagues or "sea trout," 4 per cent. Of the total production, that of oysters accounted for 50 per cent; shrimp, 38 per cent; and crabs, 5 per cent.

OPERATING UNITS BY GEAR

The catch of fishery products in Mississippi during 1928 was taken by 2,203 fishermen, who used 97 motor vessels, 44 sailing vessels, 1,079 motor and other boats, and 10 major types of gear. The motor and sailing vessels had a combined capacity of 1,852 net tons. The fisheries accounting for the greatest number of persons were the otter-trawl fishery, employing 1,122 fishermen, and the oyster-dredge fishery, employing 803 fishermen.

CATCH BY GEAR

Four types of gear caught 93 per cent of the fish taken in the marine fisheries of Mississippi during 1928. Listed in order of their importance they were: Dredges, which accounted for 41 per cent of the catch; otter trawls, 37 per cent; tongs, 9 per cent; and lines, 6 per cent.

The catch by both dredges and tongs consisted entirely of oysters, that by otter trawls principally shrimp, and that by lines principally hard crabs.

OPERATING UNITS BY COUNTIES

Only three counties in Mississippi are represented in the marine fisheries. Harrison was by far the most important of these, accounting for 87 per cent of the total number of fishermen, 99 per cent of the vessels, and 81 per cent of the small fishing boats. Jackson County ranked second with 9 per cent of the fishermen, 1 per cent of the vessels, and 15 per cent of the small fishing boats.

CATCH BY COUNTIES

Of the three counties represented in the marine fisheries of Mississippi, Harrison County accounted for 87 per cent of the total catch and 85 per cent of the value of the catch. Jackson County ranked second with 11 per cent of the catch and 12 per cent of the value, and Hancock followed with 2 per cent of the catch and 3 per cent of the value.

Fisheries of Mississippi, 1928

OPERATING UNITS: BY GEAR

Items	Haul seines, common	Trammel nets	Lines: Hand	Lines: Trot with baits or snoods	Dip nets, common	Dip nets, drop
	Number	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:						
On vessels	23	4	6			
On boats and shore, regular	118	113	99	105	30	20
Total	141	117	105	105	30	20
Vessels:						
Motor—						
5 to 10 tons		1	1			
11 to 20 tons	1					
Total	1	1	1			
Net tonnage	16	10	8			
Sail, 5 to 10 tons	2					
Total	2					
Net tonnage	18					
Total vessels	3	1	1			
Total net tonnage	34	10	8			
Boats:						
Motor	24	44	13	23		
Other	11	82	77	80		
Apparatus:						
Number	27	86	105	105	60	400
Length, yards	6, 700					
Square yards		27, 396				
Hooks, baits, or snoods			121	35, 588		

Items	Cast nets	Otter trawls, shrimp	Spears	Dredges, oyster	Tongs	By hand	Total, exclusive of duplication
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:							
On vessels		314		711	4		753
On boats and shore—							
Regular	35	808	111	92	566	86	1, 443
Casual			7			6	7
Total	35	1, 122	118	803	570	92	2, 203
Vessels:							
Motor—							
5 to 10 tons		31		34	1		47
11 to 20 tons		29		44			49
21 to 30 tons		1		1			1
Total		61		79	1		97
Net tonnage		676		941	6		1, 105
Sail—							
5 to 10 tons		1		7			7
11 to 20 tons		3		31			31
21 to 30 tons				4			4
31 to 40 tons		1		1			1
41 to 50 tons				1			1
Total		5		44			44
Net tonnage		98		747			747
Total vessels		66		123	1		141
Total net tonnage		774		1, 688	6		1, 852
Boats:							
Motor		404		18	104		553
Other	35			2	365		526
Apparatus:							
Number	35	470	118	266	570		
Yards at mouth		5, 697		327			

Fisheries of Mississippi, 1928—Continued

CATCH: BY GEAR

Species	Haul seines, common		Trammel nets		Lines: Hand		Lines: Trot with baits or snoods	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bluefish	20,522	$1,231	6,141	$323				
Blue runner or hardtail			4,000	120				
Cabio or crab eater	1,000	30	1,350	51	2,000	$60	600	$18
Catfish and bullheads	4,200	130	44,784	1,816	32,000	1,440	9,600	288
Crevalle			2,300	71				
Croaker	2,200	70	32,740	1,360	12,000	600	8,400	252
Drum, black	16,413	815	40,700	1,705	1,600	80	3,840	115
Drum, red, or redfish	24,866	1,785	170,840	15,840	8,542	738	2,940	294
Flounders	5,912	591	11,878	1,323	700	105		
Groupers					49,300	1,479		
Jewfish					5,700	171		
Kingfish or "king mackerel"			1,000	40				
King whiting or "kingfish"	5,130	205	11,891	402	2,000	100	15,000	450
Mullet	515,411	18,039	285,935	9,669				
Pigfish			1,300	49				
Pompano	1,310	196	2,669	443				
Sea bass	918	92	3,062	287			4,800	480
Sheepshead, salt-water	25,455	1,543	47,233	4,300	3,341	277	3,840	384
Snapper, red					97,328	8,036		
Spadefish	944	28	2,476	87				
Spanish mackerel	1,500	150	5,022	566	800	160	1,920	288
Spot	200	8	16,100	696			9,600	288
Squeteagues	20,607	2,091	255,883	27,285	201,007	16,080	10,000	1,400
Crabs, hard							1,422,839	31,669
Crabs, soft							40,000	3,000
Shrimp	514,920	18,068						
Total	1,161,508	45,072	947,304	66,433	416,318	29,326	1,533,379	38,926

Species	Dip nets, common		Dip nets, drop		Cast nets	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Croaker					1,000	$50
Drum, red, or redfish					800	80
Mullet					1,200	48
Sheepshead, salt-water					400	40
Crabs, hard	24,000	$1,800	64,800	$4,320		
Shrimp					17,300	1,384
Total	24,000	1,800	64,800	4,320	20,700	1,602

Species	Otter trawls, shrimp		Spears		Dredges		Tongs		By hand	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Flounders			48,520	$6,408						
Sharks	6,000	$180								
Crabs, hard									6,000	$2,000
Crabs, soft									26,816	9,016
Shrimp	11,234,305	357,796								
Oysters:										
Market, public, Mississippi					4,113,200	$125,830	2,259,446	$120,435		
Market, public, Louisiana					7,661,248	228,348				
Market, private, Mississippi					69,300	6,150	89,880	9,460		
Seed, public, Mississippi					709,149	4,654	307,398	1,858		
Terrapin									1,398	452
Total	11,240,305	357,976	48,520	6,408	12,552,897	364,982	2,656,724	131,753	34,214	11,468

Fisheries of Mississippi, 1928—Continued

OPERATING UNITS: BY COUNTIES

Items	Hancock	Harrison	Jackson
Fishermen:	*Number*	*Number*	*Number*
On vessels		743	10
On boats and shore—			
Regular	66	1,179	198
Casual	6		1
Total	72	1,922	209
Vessels:			
Motor—			
5 to 10 tons		45	2
11 to 20 tons		49	
21 to 30 tons		1	
Total		95	2
Net tonnage		1,087	18
Sail—			
5 to 10 tons		7	
11 to 20 tons		31	
21 to 30 tons		4	
31 to 40 tons		1	
41 to 50 tons		1	
Total		44	
Net tonnage		747	
Total vessels		139	2
Total net tonnage		1,834	18
Boats:			
Motor	8	489	56
Other	36	381	109
Apparatus:			
Haul seines, common		16	11
Yards		3,500	3,200
Trammel nets	11	45	30
Square yards	4,033	14,363	9,000
Lines—			
Hand	20	57	28
Hooks	20	57	44
Trot with baits or snoods		91	14
Baits or snoods		25,700	9,888
Dip nets—			
Common		60	
Drop	400		
Cast nets	25	10	
Otter trawls, shrimp		447	23
Yards at mouth		5,422	275
Spears	6	80	32
Dredges, oyster		266	
Yards at mouth		327	
Tongs	22	462	86

CATCH: BY COUNTIES

Species	Hancock		Harrison		Jackson	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bluefish			2,215	$88	24,448	$1,469
Blue runner or hardtail			4,000	120		
Cabio or crab eater			1,800	54	3,150	105
Catfish and bullheads	29,400	$1,470	41,784	1,553	19,400	651
Crevalle			2,100	63	200	8
Croaker	21,000	1,050	30,690	1,121	4,650	161
Drum, black	13,500	675	26,774	905	22,279	1,135
Drum, red, or redfish	42,300	4,230	112,664	10,667	53,024	3,840
Flounders	8,320	1,248	39,650	5,235	19,040	1,944
Groupers					49,300	1,479
Jewfish					5,700	171
Kingfish or "king mackerel"			1,000	40		
King whiting or "kingfish"	1,660	83	24,913	777	7,448	297
Mullet	4,400	176	63,067	1,928	735,079	25,652
Pigfish			300	9	1,000	40
Pompano	110	27	919	163	2,950	449
Sea bass	220	33	6,300	600	2,260	226
Sharks			6,000	180		

Fisheries of Mississippi, 1928—Continued

CATCH: BY COUNTIES—Continued

Species	Hancock		Harrison		Jackson	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Sheepshead, salt-water	18,100	$1,810	28,524	$2,672	33,645	$2,062
Snapper, red					97,328	8,036
Spadefish			1,400	52	2,020	63
Spanish mackerel	500	100	6,542	834	2,200	230
Spot	7,700	385	16,900	555	1,300	52
Squeteagues	77,240	8,872	195,198	21,816	215,059	16,168
Crabs, hard	64,800	4,320	1,164,400	29,660	288,439	5,809
Crabs, soft	3,456	1,296	60,960	9,820	2,400	900
Shrimp	12,500	1,000	10,848,720	348,239	905,305	28,009
Oysters:						
Market, public, Mississippi	141,120	8,400	5,596,255	210,897	635,271	26,968
Market, public, Louisiana			7,661,248	228,348		
Market, private, Mississippi			159,180	15,610		
Seed, public, Mississippi			709,149	4,654	307,398	1,858
Terrapin			1,398	452		
Total	446,326	35,175	26,814,050	897,112	3,440,293	127,779

INDUSTRIES RELATED TO THE FISHERIES

Transporting trade.—In 1928 there were 4 persons in Mississippi engaged in transporting the catch of fish. In this trade, 2 motor vessels having a total capacity of 19 net tons were operated.

Wholesale trade.—There were 26 wholesale establishments on the coast of Mississippi engaged chiefly in handling fresh and frozen fishery products. This is 10 per cent of the total number of such establishments in the Gulf section. These establishments employed 233 persons who received $121,295 in salaries and wages. There were 19 of these establishments located in Harrison County.

Prepared and by-products trade.—There were 23 establishments on the coast of Mississippi during 1928 engaged primarily in the manufacture of prepared fishery products or by-products. This is 24 per cent of the total number in the Gulf section. They employed 791 persons who received $499,794 in salaries and wages. The products manufactured, consisting principally of canned oysters and shrimp, were valued at $1,899,999. Detailed statistics of most of the items manufactured may be obtained from Fishery Industries of the United States, 1928, Bureau of Fisheries Document No. 1067.

In addition to the above, 84,824 pounds of salted mullet and mullet roe valued at $4,723 were prepared by the fishermen.

Industries related to the fisheries of Mississippi, 1928

TRANSPORTING

Items	Number
Men on transporting vessels	4
Transporting vessels:	
Motor—	
5 to 10 tons	1
11 to 20 tons	1
Total vessels	2
Total net tonnage	19

Industries related to the fisheries of Mississippi, 1928—Continued

WHOLESALE FISHERY TRADE

Items	Harrison County	Jackson and Hancock Counties	Total
Establishments	19	7	26
Persons engaged:			
Proprietors	24	9	33
Salaried employees	11	4	15
Wage earners	150	35	185
Paid to salaried employees	$17,698	$10,870	$28,568
Paid to wage earners	68,464	24,263	92,727
Total salaries and wages paid	86,162	35,133	121,295

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS

Items	Number	Products [1]	Quantity	Value
Establishments	23	Salted:		
Persons engaged:		Mullet ... pounds	261,323	$20,285
Proprietors	37	Mullet roe ... do	2,375	594
Salaried employees	57	Canned:		
Wage earners	697	Oysters ... standard cases [2]	205,115	1,119,123
		Shrimp—		
Paid to salaried employees	$151,357	Dry pack ... do	54,429	302,681
Paid to wage earners	348,437	Wet pack ... do	55,487	324,269
		Oyster shell products:		
Total salaries and wages paid	499,794	Poultry feed ... tons	15,684	131,761
		Other products [3]		1,286
		Total		1,899,999

PRODUCTS PREPARED BY THE FISHERMEN

Salted	Pounds	Value
Mullet	84,424	$4,643
Mullet roe	400	80
Total	84,824	4,723

[1] Includes the salted mullet roe and canned shrimp prepared by three firms whose activities were principally in the wholesale fishery trade.
[2] A standard case contains forty-eight 5-ounce cans of oysters; forty-eight 5-ounce cans in the dry pack, or forty-eight 5¾-ounce cans in the wet pack of shrimp.
[3] Includes lime from oyster shells and canned crabs.

LOUISIANA

In 1928 the fisheries of Louisiana ranked first among the States bordering on the Gulf of Mexico with respect to the volume of the catch, employing 32 per cent of the total number of fishermen and accounting for 36 per cent of the total catch. The fisheries and industries related to the fisheries employed 6,806 persons which is 4 per cent less than the number in 1927. Of the total, 5,152 were fishermen, 28 were employed on transporting vessels, 324 in the wholesale trade, and 1,302 in the prepared-products and by-products industries.

The total catch amounted to 69,506,979 pounds, valued at $3,477,866. This is an increase of 24 per cent in the catch and 21 per cent in the value of the catch, compared with the catch and its value for

1927. Of the total value of the catch, that for shrimp accounting for 62 per cent; oysters, 27 per cent; and crabs, 4 per cent. Of the total production, shrimp accounted for 77 per cent; oysters, 16 per cent; and crabs 4 per cent.

OPERATING UNITS BY GEAR

The catch of fishery products on the coast of Louisiana during 1928 was taken by 5,152 fishermen who used 185 motor vessels, 3 sailing vessels, 2,709 motor and other boats, and 7 major types of gear. The motor and sailing vessels had a combined capacity of 1,390 net tons. The fisheries accounting for the greatest number of persons were the otter-trawl fishery employing 2,341 fishermen and the haul-seine fishery with 1,700 fishermen.

CATCH BY GEAR

Three types of gear caught 88 per cent of the fish taken in the marine fisheries of Louisiana during 1928. Listed in order of their importance they were otter trawls, which accounted for 60 per cent of the catch; haul seines, 19 per cent; and tongs, 9 per cent.

The catch by otter trawl consisted entirely of shrimp, that by haul seines principally shrimp, and that by tongs exclusively oysters.

OPERATING UNITS BY PARISHES

Terrebonne Parish was foremost in the number of persons fishing, accounting for 22 per cent of the total. Jefferson Parish followed with 21 per cent. Other parishes employing a considerable number of fishermen listed in order of their importance in this respect were La Fourche, St. Bernard, and Plaquemines. La Fourche Parish accounted for 32 per cent of the total number of fishing vessels and Terrebonne Parish 27 per cent. Terrebonne Parish led in the number of small motor and other types of fishing boats, accounting for 25 per cent of the total. Jefferson Parish followed with 20 per cent.

CATCH BY PARISHES

Fishing was prosecuted in the marine waters of 14 parishes of Louisiana in 1928. Ranked according to value, the fisheries of Terrebonne Parish were most important, accounting for 24 per cent of the total catch and 22 per cent of the total value of the catch. Jefferson Parish ranked second with 24 per cent of the total catch and 20 per cent of the value. Other important parishes listed in order with respect to value of the catch were La Fourche, Plaquemines, and Orleans.

Fisheries of Louisiana, 1928

OPERATING UNITS: BY GEAR

Items	Haul seines	Trammel nets	Lines: Hand	Lines: Trot with baits or snoods	Dip nets, drop
	Number	*Number*	*Number*	*Number*	*Number*
Fishermen:					
On vessels		6			
On boats and shore—					
Regular	1,700	202	317	343	126
Casual			25		50
Total	1,700	208	342	343	176
Vessels:					
Motor—					
5 to 10 tons		2			
11 to 20 tons		1			
Total		3			
Net tonnage		23			
Boats:					
Motor	269	100	67	65	1
Other	283	99	326	293	176
Apparatus:					
Number	292	103	342	293	11,340
Length, yards	56,665				
Square yards		26,299			
Hooks, baits, or snoods			347	71,350	

Items	Otter trawls, shrimp	Dredges	Tongs	By hand	Total, exclusive of duplication
	Number	*Number*	*Number*	*Number*	*Number*
Fishermen:					
On vessels	247	133	195		506
On boats and shore—					
Regular	2,094	59	418	12	4,571
Casual					75
Total	2,341	192	613	12	5,152
Vessels:					
Motor—					
5 to 10 tons	100	28	67		164
11 to 20 tons	6	5	8		20
21 to 30 tons	1				1
Total	107	33	75		185
Net tonnage	733	269	541		1,360
Sail—					
5 to 10 tons		1			1
11 to 20 tons	1	2			2
Total	1	3			3
Net tonnage	12	30			30
Total vessels	108	36	75		188
Total net tonnage	745	299	541		1,390
Boats:					
Motor	1,043	14	164		1,542
Other		12	157	12	1,167
Apparatus:					
Number	1,151	86	611		
Yards at mouth	14,717	90			

Fisheries of Louisiana, 1928—Continued

CATCH: BY GEAR

Species	Haul seines		Trammel nets		Lines, hand	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Angelfish	100	$6				
Bluefish	200	30				
Buffalofish	3,200	310				
Catfish	279,747	14,159	23,100	$1,121	37,350	$1,794
Croaker	56,860	2,971	55,700	2,722	55,940	2,863
Drum, black	82,900	4,669	62,200	3,251	18,200	800
Drum, red, or redfish	146,905	17,105	205,277	21,465	81,392	8,168
Flounders	5,395	794	5,775	676	1,725	172
Garfish	6,000	600	3,000	300		
Groupers					500	30
Jewfish					2,000	120
King whiting or "kingfish"	22,995	1,006	24,300	1,049	14,255	591
Mullet	11,000	510	12,100	455		
Pompano	1,021	181	829	123		
Sea bass	1,500	150				
Sheepshead, salt-water	50,519	6,062	38,870	4,007	18,801	1,860
Snapper, red					48,000	6,720
Spanish mackerel	16,557	2,366	5,314	703	300	15
Spot	19,500	1,030	13,750	625	1,600	168
Squeteague or "sea trout"	249,147	32,431	343,775	40,852	291,608	35,748
Yellowtail					2,800	112
Shrimp	12,371,340	496,246				
Terrapin	42,441	14,316				
Total	13,367,327	594,942	793,990	77,349	574,471	59,161

Species	Lines, trot with baits or snoods		Dip nets, drop		Otter trawls, shrimp	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Crabs, hard	2,099,010	$59,366	221,120	$19,244		
Crabs, soft			182,960	52,424		
Shrimp			15,600	7,800	41,392,463	$1,655,313
Total	2,099,010	59,366	419,680	79,468	41,392,463	1,655,313

Species	Dredges		Tongs		By hand	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Oysters, market, public	1,424,213	$42,858	81,900	$10,575		
Oysters, market, private	3,262,630	316,878	6,079,920	576,456		
Terrapin					11,375	$5,500
Total	4,686,843	359,736	6,161,820	587,031	11,375	5,500

OPERATING UNITS: BY PARISHES

Items	Ascension	Cameron	Iberia	Jeff Davis	Jefferson	La Fourche	Orleans
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:							
On vessels					29	164	51
On boats and shore—							
Regular	7	7	35	2	1,014	598	321
Casual					25		
Total	7	7	35	2	1,068	762	372
Vessels:							
Motor—							
5 to 10 tons					10	56	12
11 to 20 tons					1	5	4
21 to 30 tons					1		
Total					12	61	16
Net tonnage					109	431	137

Fisheries of Louisiana, 1928—Continued

OPERATING UNITS: BY PARISHES—Continued

Items	Ascension	Cameron	Iberia	Jeff Davis	Jefferson	La Fourche	Orleans
Boats:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Motor	2	3	10	1	292	236	110
Other	2	1	10		243	69	74
Apparatus:							
Haul seines		1			78	18	8
Length, yards		150			13, 284	4, 050	2, 050
Trammel nets			5		10	6	13
Square yards			1, 111		2, 090	1, 800	3, 050
Lines—							
Hand					50		13
Hooks					50		18
Trot with baits or snoods					110	32	
Baits or snoods					19, 250	5, 300	
Dip nets, drop							5, 065
Otter trawls, shrimp				1	237	225	78
Yards at mouth				12	3, 092	2, 835	1, 015
Dredges						10	19
Yards at mouth						11	19
Tongs	7	4	25		31	191	20

Items	Plaquemines	St. Bernard	St. Mary	St. Tammany	Tangipahoa	Terrebonne	Vermilion
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	79	38	31	4		110	
On boats and shore—							
Regular	656	660	113	65	5	1, 034	54
Casual		50					
Total	735	748	144	69	5	1, 144	54
Vessels:							
Motor—							
5 to 10 tons	21	4	12	1		48	
11 to 20 tons	3	2	1	1		3	
Total	24	6	13	2		51	
Net tonnage	170	56	106	22		329	
Sail—							
5 to 10 tons		1					
11 to 20 tons		2					
Total		3					
Net tonnage		30					
Total vessels	24	9	13	2		51	
Total net tonnage	170	86	106	22		329	
Boats:							
Motor	217	196	44	8		401	22
Other	114	285	26	45	5	281	12
Apparatus:							
Haul seines	20	39	3	4		111	10
Length, yards	5, 150	11, 300	600	726		17, 905	1, 450
Trammel nets	26	19	5	1		16	2
Square yards	4, 328	5, 583	1, 750	267		5, 920	400
Lines—							
Hand	35	134		30		80	
Hooks	35	134		30		80	
Trot with baits or snoods	20	116	12		3		
Baits or snoods	2, 700	34, 000	9, 500		600		
Dip nets, drop		5, 420		525	80	250	
Otter trawls, shrimp	143	99	39	5		315	9
Yards at mouth	1, 852	1, 294	487	63		3, 959	108
Dredges	29	17	9			2	
Yards at mouth	29	20	9			2	
Tongs	104		26	10		189	4

Fisheries of Louisiana, 1928—Continued

CATCH: BY PARISHES

Species	Ascension		Cameron		Iberia		Jeff Davis	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Catfish					2,000	$160		
Croaker					3,000	240		
Drum, black					3,500	280		
Drum, red, or redfish					8,000	800		
Flounders					600	60		
Sheepshead, salt-water					900	72		
Squeteague or "sea trout"					13,500	1,350		
Shrimp			10,000	$600			8,000	$480
Oysters:								
Market, public			10,500	1,125				
Market, private	31,500	$4,500			115,500	16,500		
Total	31,500	4,500	20,500	1,725	147,000	19,462	8,000	480

Species	Jefferson		La Fourche		Orleans		Plaquemines	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Catfish	13,400	$491	200	$10	15,100	$872	12,500	$500
Croaker	9,400	376	600	30	21,800	1,484	42,750	1,710
Drum, black	28,400	1,136	5,900	295	7,300	401	21,800	872
Drum, red, or redfish	40,400	4,900	24,000	2,400	29,800	3,321	84,350	8,435
Flounders			100	10	450	58	2,750	275
Groupers					500	30		
Jewfish					2,000	120		
King whiting or "kingfish"	22,200	888	1,500	75	2,000	98	18,700	748
Mullet	4,000	120			4,000	200	5,500	165
Pompano	200	49	100	15	200	40	200	30
Sea bass	1,500	150						
Sheepshead, salt-water	9,000	666	3,500	350	9,100	1,176	16,950	1,695
Snapper, red					48,000	6,720		
Spanish mackerel	800	120	200	20	200	30	900	90
Spot	3,300	132			3,600	174	5,300	212
Squeteague or "sea trout"	153,300	13,993	26,500	2,525	52,400	8,180	173,100	19,631
Yellowtail	2,800	112						
Crabs, hard	1,040,000	26,000	240,000	4,650	126,400	11,880	264,000	4,900
Crabs, soft					60,800	26,600		
Shrimp	15,085,675	603,431	9,529,852	381,194	2,928,255	117,129	5,834,146	233,365
Oysters:								
Market, public			28,749	821	4,200	600	38,850	1,850
Market, private	215,481	20,522	2,439,661	232,349	1,601,271	152,502	3,199,434	304,708
Terrapin	25,520	10,235					11,375	5,500
Total	16,655,376	683,321	12,300,862	624,744	4,917,376	331,615	9,732,605	584,686

Species	St. Bernard		St. Mary		St. Tammany	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Angelfish					100	$6
Bluefish					100	20
Buffalofish	200	$10			3,000	300
Catfish	87,150	4,193			11,500	920
Croaker	79,500	3,815	2,500	$120	1,000	150
Drum, black	31,250	1,472	1,800	144	650	65
Drum, red, or redfish	67,250	7,316	6,000	600	9,200	1,749
Flounders	6,000	830	300	30	300	60
King whiting or "kingfish"	9,200	438			150	9
Mullet	2,000	100			5,000	250
Pompano	300	45			200	60
Sheepshead, salt-water	36,100	3,610	400	32	8,800	1,699
Spanish mackerel	16,550	2,452			200	40
Spot	21,450	1,125			1,200	180
Squeteagues or "sea trout"	225,500	32,225	9,500	1,235	48,000	11,560
Crabs, hard	429,810	22,861	178,000	4,450	20,160	2,016
Crabs, soft	109,680	21,144			8,640	3,240
Shrimp	4,264,002	177,476	1,279,477	51,690	117,652	4,706
Oysters:						
Market, public	1,356,614	40,187			46,200	6,600
Market, private			370,678	41,454		
Total	6,742,556	319,299	1,848,655	99,755	282,052	33,630

Fisheries of Louisiana, 1928—Continued.

CATCH: BY PARISHES—Continued

Species	Tangipahoa		Terrebonne		Vermilion	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bluefish			100	$10		
Catfish			197,997	9,900	350	$28
Croaker			6,400	321	1,550	310
Drum, black			53,500	2,675	9,200	1,380
Drum, red, or redfish			156,974	15,697	7,600	1,520
Flounders			1,595	159	800	160
Garfish					9,000	900
King whiting or "kingfish"			7,800	390		
Mullet			2,600	130		
Pompano			650	65		
Sheepshead, salt-water			17,740	1,774	5,700	855
Spanish mackerel			3,321	332		
Squeteagues or "sea trout"			175,630	16,912	7,100	1,420
Crabs, hard	11,760	$1,103	10,000	750		
Crabs, soft	3,840	1,440				
Shrimp			14,539,994	580,699	182,350	8,589
Oysters:						
Market, public					21,000	2,250
Market, private			1,369,025	120,799		
Terrapin			16,921	4,081		
Total	15,600	2,543	16,560,247	754,694	244,650	17,412

INDUSTRIES RELATED TO THE FISHERIES

Transporting trade.—In 1928 there were 28 persons in Louisiana engaged primarily in transporting the catch of fish. In this trade there were 12 motor vessels having a combined capacity of 135 net tons, and 1 sailing vessel having a capacity of 16 net tons. The size of vessel in most popular use ranged from 5 to 10 net tons.

Wholesale trade.—There were 36 establishments in Louisiana engaged chiefly in handling fresh and frozen fish. This is 14 per cent of the total number of such establishments in the Gulf section. These establishments employed 324 persons who received $286,116 in salaries and wages. Orleans Parish accounted for 18 of these establishments.

Prepared and by-products trade.—There were 48 establishments in Louisiana in 1928 engaged primarily in the manufacture of prepared fishery products or by-products. This is 49 per cent of the total number in the Gulf section. They employed 1,302 persons who received $677,510 in salaries and wages. The products manufactured, consisting principally of canned shrimp and oyster-shell products, were valued at $4,577,468. Detailed statistics of most of the items manufactured may be obtained from Fishery Industries of the United States, 1928, Bureau of Fisheries Document No. 1067.

Industries related to the fisheries of Louisiana, 1928

TRANSPORTING

Items	Number	Items	Number
Men on transporting vessels	28	Transporting vessels—Continued.	
Transporting vessels:		Sail	1
Motor—		Net tonnage	16
5 to 10 tons	8	Total vessels	13
11 to 20 tons	3	Total net tonnage	151
41 to 50 tons	1		
Total	12		
Net tonnage	135		

Industries related to the fisheries of Louisiana, 1928—Continued

WHOLESALE FISHERY TRADE

Items	Jefferson	Orleans	Plaquemines and St. Bernard	St. Marys and Iberia	Terrebonne	Total
Establishments	4	18	4	3	7	36
Persons engaged:						
Proprietors	4	33	4	6	11	58
Salaried employees	1	23	----------	1	11	36
Wage earners	7	104	16	14	89	230
Paid to salaried employees	$2,400	$101,177	$2,110	$1,600	$23,454	$130,741
Paid to wage earners	5,780	94,015	10,040	5,799	39,741	155,375
Total salaries and wages	8,180	195,192	12,150	7,399	63,195	286,116

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS

Items	Number
Establishments	48
Persons engaged:	
Proprietors	65
Salaried employees	103
Wage earners	1,134
Paid to salaried employees	$228,120
Paid to wage earners	449,390
Total salaries and wages	677,510

Products [1]	Quantity	Value
Canned:		
Oysters ...standard cases [2]	34,091	$190,483
Shrimp—		
Dry pack ...do	220,690	1,336,208
Wet pack ...do	221,564	1,298,608
Oyster-shell products:		
Poultry feed ...tons	123,354	1,126,619
Lime ...do	10,130	17,392
Shrimp bran ...do	1,726	58,080
Dried shrimp ...do	1,082	542,376
Dried squeteague ...pounds	28,535	7,702
Total	----------	4,577,468

[1] Includes a small amount of shrimp bran prepared by one firm, whose activities were principally in the wholesale fishery trade.
[2] A standard case contains forty-eight 5-ounce cans of oysters; forty-eight 5-ounce cans in the dry pack, or forty-eight 5¾-ounce cans in the wet pack of shrimp.

TEXAS

The fisheries of Texas in 1928 employed 14 per cent of the total number of fishermen and accounted for 8 per cent of the total catch of the Gulf section. The fisheries and industries related to the fisheries employed 2,881 persons, which is 8 per cent greater than the number in 1927. Of the total, 2,347 were fishermen, 401 were employed in the wholesale trade, and 133 in the prepared-products and by-products industries.

The total catch amounted to 15,212,493 pounds, valued at $875,058. This is a decrease of 28 per cent in the catch and 17 per cent in the value of the catch, compared with the catch and its value for 1927. Of the total value of catch, that for shrimp accounted for 30 per cent; squeteagues or "sea trout," 17 per cent; oysters, 15 per cent; and red drum or redfish, 13 per cent. Of the total production, that of shrimp accounted for 51 per cent; oysters, 12 per cent; squeteagues or "sea trout," 8 per cent; and red snapper and red drum or redfish, each, 7 per cent.

OPERATING UNITS BY GEAR

The catch of fishery products on the coast of Texas during 1928 was taken by 2,347 fishermen, who used 45 motor vessels, 4 sailing vessels, 1,401 motor and other boats, and 10 major types of gear. The motor and sailing vessels had a combined capacity of 600 net tons. The fisheries accounting for the greatest number of persons were the hand-line fishery, employing 554 fishermen and the otter-trawl fishery employing 547 fishermen.

CATCH BY GEAR

Four types of gear accounted for 85 per cent of the fish taken in the marine fisheries of Texas during 1928. Listed in order of their importance they were otter trawls, which accounted for 51 per cent of the catch; haul seines, 14 per cent; lines, 13 per cent; and tongs, 7 per cent.

The catch by otter trawls consisted principally of shrimp, that by haul seines principally black drum, squeteagues or "sea trout," and red drum or redfish; that by lines principally red snapper; and that by tongs exclusively oysters.

OPERATING UNITS BY COUNTIES

Neuces County was foremost in the number of persons fishing, accounting for 28 per cent of the total number. Galveston followed with 22 per cent. Other counties employing a considerable number of fishermen listed in order of their importance in this respect were Calhoun, Cameron, and Matagorda. Galveston County accounted for 39 per cent of the total number of fishing vessels and Calhoun County 25 per cent. Neuces led in the number of small motor and other types of fishing boats, accounting for 25 per cent of the total, and was followed by Galveston County with 19 per cent of the total.

CATCH BY COUNTIES

Fishing was prosecuted in the marine waters of 13 counties of Texas in 1928. Ranked according to value, the fisheries of Galveston County were most important, accounting for 31 per cent of the total catch and 33 per cent of the total value of the catch. Neuces County was next in the value of the catch, accounting for 19 per cent of the quantity and 17 per cent of the total value. Other important counties listed in order with respect to the value of the catch were Calhoun, Cameron, San Patricio, and Aransas.

Fisheries of Texas, 1928

OPERATING UNITS: BY GEAR

Items	Haul seines		Gill nets, set	Trammel nets	Cast nets
	Common	Long			
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	4			2	
On boats and shore—					
Regular	149	342	156	169	4
Casual	75		4	8	5
Total	228	342	160	179	9
Vessels:					
Motor—					
5 to 10 tons	1				
Total	1				
Net tonnage	5				
Sail—					
5 to 10 tons				1	
Total				1	
Net tonnage				6	
Total vessels	1			1	
Total net tonnage	5			6	
Boats:					
Motor	27	8	56	87	
Other	38	180	99	102	4
Apparatus:					
Number	94	92	541	108	9
Length, yards	18,686	29,332			
Square yards			98,496	42,078	

Fisheries of Texas, 1928—Continued

OPERATING UNITS: BY GEAR—Continued

Items	Dip nets		Lines		
	Common	Drop	Hand	Trot, with hooks	Trot, with baits or snoods
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels			86		
On boats and shore—					
Regular	30	10	191	76	16
Casual			277	8	4
Total	30	10	554	84	20
Vessels:					
Motor—					
5 to 10 tons			1		
11 to 20 tons			6		
41 to 50 tons			2		
Total			9		
Net tonnage			185		
Sail—					
31 to 40 tons			1		
71 to 80 tons			1		
Total			2		
Net tonnage			118		
Total vessels			11		
Total net tonnage			303		
Boats:					
Motor			139	25	2
Other	15	10	194	74	20
Apparatus:					
Number	30	200	799	276	36
Hooks, snoods, or baits			898	43, 400	9, 280

Items	Otter trawls, shrimp	Spears	Oyster dredges	Tongs	By hand	Total, exclusive of duplication
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	84		21	18		175
On boats and shore—						
Regular	463	103	130	284	10	1, 619
Casual		62		107	25	553
Total	547	165	151	409	35	2, 347
Vessels:						
Motor—						
5 to 10 tons	28		5	3		31
11 to 20 tons	6		1	3		12
41 to 50 tons						2
Total	34		6	6		45
Net tonnage	275		58	54		470
Sail—						
5 to 10 tons				1		2
31 to 40 tons						1
71 to 80 tons						1
Total				1		4
Net tonnage				6		130
Total vessels	34		6	7		49
Total net tonnage	275		58	60		600
Boats:						
Motor	228	4	40	89	4	569
Other		1		204	25	832
Apparatus:						
Number	262	165	52	407		
Yards at mouth	3, 909		52			

Fisheries of Texas, 1928—Continued

CATCH: BY GEAR

Species	Haul seines				Gill nets, set		Trammel nets	
	Common		Long					
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bluefish			200	$30				
Buffalofish	34,887	$2,222			50,221	$2,581	3,382	$175
Butterfish							1,000	30
Catfish	35,400	1,883	24,880	972	19,060	782	50,462	2,053
Crevalle	50	2	696	28	500	20		
Croaker	5,260	251	42,270	1,691	9,753	415	24,147	1,288
Drum, black	45,566	1,921	740,912	29,637	145,928	5,836	51,915	2,596
Drum, red, or redfish	101,730	10,231	268,944	26,894	171,364	17,925	305,169	38,907
Flounders	60	7	6,330	757	966	111	4,033	709
King whiting or "kingfish"	9,150	659	2,137	85	5,209	252	1,900	111
Mullet			3,000	60	150	7	11,250	338
Pompano	3,150	767	2,924	488	2,671	673	1,790	474
Sea bass			2,500	250				
Sheepshead, fresh-water	6,000	350			300	36		
Sheepshead, salt-water	7,208	508	19,767	1,217	2,783	167	15,266	1,440
Snook or sergeantfish	51,370	4,329	135,513	13,551	26,017	2,736	5,825	585
Spadefish	2,175	143	2,000	80				
Spanish mackerel	6,000	1,200	518	90	1,678	184	2,200	440
Squeteague or "sea trout"	153,691	21,069	332,087	37,671	143,869	17,760	321,251	49,016
Tuna or horse mackerel			100	4	632	25	316	12
Shrimp	50,000	2,000						
Total	511,697	47,542	1,584,778	113,505	581,101	49,510	799,906	98,174

Species	Lines					
	Hand		Trot with hooks		Trot with baits or snoods	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bluefish	500	$40				
Catfish	41,977	1,690	139,500	$7,515		
Croaker	3,450	138				
Drum, black	10,949	457	1,200	48		
Drum, red, or redfish	113,900	12,166	64,903	6,566		
Flounders	5,653	673				
Groupers	21,617	698				
Jewfish	75,746	4,477				
Kingfish or "king mackerel"	11,300	484				
King whiting or "kingfish"	1,500	90				
Pompano	360	72				
Sea bass	1,450	91				
Sheepshead, fresh-water			500	25		
Sheepshead, salt-water	7,779	379				
Snapper, red	1,055,162	88,792				
Snook or sergeantfish	10,750	995	800	80		
Spadefish	650	26				
Spanish mackerel	77,868	8,155				
Squeteague or "sea trout"	197,701	25,394	6,300	756		
Crabs, hard					82,400	$5,980
Total	1,638,312	144,817	213,203	14,990	82,400	5,980

Species	Dip nets				Cast nets		Otter trawls, shrimp	
	Common		Drop					
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
King whiting or "kingfish"							4,000	$200
Squeteague or sea trout							5,000	250
Crabs, hard	10,900	$545	203,200	$5,340			4,000	200
Shrimp					10,000	$1,500	7,714,272	257,650
Turtles							900	27
Total	10,900	545	203,200	5,340	10,000	1,500	7,728,172	258,327

Fisheries of Texas, 1928—Continued

CATCH: BY GEAR—Continued

Species	Spears		Dredges		Tongs		By hand	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Drum, red, or redfish	3,872	$391						
Flounders	35,360	4,333						
Sheepshead, salt-water	1,961	146						
Oysters:								
Market, public			668,710	$38,870	1,042,216	$80,612	49,455	$3,773
Market, private					47,250	6,703		
Total	41,193	4,870	668,710	38,870	1,089,466	87,315	49,455	3,773

OPERATING UNITS: BY COUNTIES

Items	Aransas	Brazoria	Calhoun	Cameron	Chambers	Galveston	Harris
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	2		31			99	2
On boats and shore—							
Regular	122	10	215	218	33	309	38
Casual	50		52	25		101	8
Total	174	10	298	243	33	509	48
Vessels:							
Motor—							
5 to 10 tons	1		8			9	
11 to 20 tons			3			6	1
41 to 50 tons						2	
Total	1		11			17	1
Net tonnage	7		92			240	11
Sail—							
5 to 10 tons			1				
31 to 40 tons						1	
71 to 80 tons						1	
Total			1			2	
Net tonnage			6			118	
Total vessels	1		12			19	1
Total net tonnage	7		98			358	11
Boats:							
Motor	32	4	112	1	23	125	21
Other	83	10	105	112	22	136	34
Apparatus:							
Haul seines—							
Common	2		11	1	5	46	2
Yards	700		3,050	620	2,000	7,066	700
Long	3			44			
Yards	600			12,800			
Gill nets, set	221		14		64	43	
Square yards	22,100		1,192		14,223	7,997	
Trammel nets	11	4	41			26	11
Square yards	4,400	1,200	16,694			8,500	3,222
Lines—							
Hand	41		55			133	3
Hooks	41		55			211	6
Trot with hooks	46		18		60		36
Hooks	6,000		2,800		8,000		14,400
Trot with baits or snoods						30	6
Baits or snoods						5,680	3,600
Dip nets—							
Common	30						
Drop						165	
Otter trawls, shrimp	15		71			56	
Yards at mouth	225		1,065			764	
Spears	16		43			24	
Dredges, oyster	3		7		1	25	
Yards at mouth	3		7		1	25	
Tongs	60		46			69	14

Fisheries of Texas, 1928—Continued

OPERATING UNITS: BY COUNTIES—Continued

Items	Jefferson	Matagorda	Nueces	Orange	Refugio	San Patricio
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	3	15	17			6
On boats and shore—						
Regular	4	155	419	6	2	88
Casual	8	35	218		16	40
Total	15	205	654	6	18	134
Vessels:						
Motor—						
5 to 10 tons	1	4	6			2
11 to 20 tons		1	1			
Total	1	5	7			2
Net tonnage	8	46	53			13
Sail—						
5 to 10 tons		1				
Total		1				
Net tonnage		6				
Total vessels	1	6	7			2
Total net tonnage	8	52	53			13
Boats:						
Motor		64	141		1	45
Other	5	69	203	6	14	33
Apparatus:						
Haul seines—						
Common	1	3	23			
Yards	200	900	3,450			
Long		8	37			
Yards		3,532	12,400			
Gill nets, set		50	75		5	69
Square yards		10,397	21,835		665	17,087
Trammel nets		6	9			
Square yards		4,465	3,597			
Lines—						
Hand	7	20	430		10	100
Hooks	10	20	445		10	100
Trot with hooks		66	8	24	12	6
Hooks		2,200	1,200	7,000	1,000	800
Dip nets—						
Drop	35					
Cast nets	9					
Otter trawls, shrimp		19	62			39
Yards at mouth		285	962			608
Spears		43	23			16
Dredges, oyster		14	2			
Yards at mouth		14	2			
Tongs		66	142		10	

CATCH: BY COUNTIES

Species	Aransas		Brazoria		Calhoun		Cameron	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Angelfish	400	$16					2,000	$80
Bluefish							100	15
Buffalofish					12,490	$499		
Butterfish					1,000	30		
Catfish	55,284	2,211	1,000	$60	81,303	3,039	9,000	360
Crevalle							200	8
Croaker	12,180	487	900	45	5,152	205	32,452	1,298
Drum, black	33,096	1,339	500	25	36,889	1,493	425,141	17,006
Drum, red, or redfish	144,702	14,471	8,500	1,020	177,072	17,922	145,142	14,014
Flounders	8,216	903			9,092	998	400	44
King whiting or "kingfish"	1,434	57	200	10	1,700	68		
Mullet							3,000	60
Pompano	624	160					1,854	334
Sea bass							2,500	250
Sheepshead, salt-water	1,416	85	200	20	7,730	613	15,328	920
Snook or sergeantfish	20,302	2,030			2,525	255	160,828	15,383
Spanish mackerel	1,678	184			368	55	400	72
Squeteagues or "sea trout"	88,522	10,564	5,500	770	190,422	22,180	257,761	27,454
Tuna or horse mackerel	1,048	41						
Crabs, hard	10,900	545						
Shrimp	508,556	20,342			1,510,290	52,861		
Oysters:								
Market, public	92,757	8,613	41,055	2,933	164,556	10,291	8,400	840
Market, private	1,050	103						
Total	982,165	62,151	57,855	4,883	2,200,589	110,509	1,064,506	78,138

Fisheries of Texas, 1928—Continued

CATCH: BY COUNTIES—Continued

Species	Chambers		Galveston		Harris		Jefferson	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Angelfish			1,875	$131				
Buffalofish	43,000	$2,364			18,500	$1,180		
Catfish	26,500	2,340	23,850	1,375	61,000	2,410	1,900	$152
Croaker	100	5	15,350	938	500	46	200	12
Drum, black	300	16	14,100	849	5,150	512	200	12
Drum, red, or redfish	1,800	244	129,850	19,490	36,000	6,480	3,000	540
Flounders			6,350	1,270	100	18		
Groupers			19,451	581			1,000	70
Jewfish			50,430	3,283			4,000	280
King whiting or "kingfish"	200	20	10,150	755	400	40	100	15
Mullet			11,250	338				
Pompano			1,870	494	50	9		
Sea bass							1,000	70
Sheepshead, salt-water	150	15	11,625	1,165	700	72	100	15
Sheepshead, fresh-water	5,500	275			1,000	100		
Snapper, red			948,742	75,900			45,000	6,750
Snook or sergeantfish			120	24				
Spanish mackerel			18,200	3,640				
Squeteagues or "sea trout"	4,200	830	232,400	41,545	53,500	9,640	4,800	960
Crabs, hard			248,800	8,400	36,000	2,700	4,800	420
Shrimp			2,409,771	85,243			10,000	1,500
Oysters:								
Market, public	16,800	800	579,796	36,809	67,620	6,885		
Market, private			46,200	6,600				
Turtles			900	27				
Total	98,550	6,909	4,781,080	288,860	280,520	30,422	76,100	10,796

Species	Matagorda		Nueces		Orange	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Angelfish			550	$22		
Bluefish			600	55		
Buffalofish	12,000	$510				
Catfish	24,862	1,381	9,880	296	10,000	$1,000
Crevalle			1,046	42		
Croaker	5,700	228	10,596	424		
Drum, black	11,237	449	413,363	16,534		
Drum, red, or redfish	42,127	4,212	243,739	24,074		
Flounders	5,058	634	19,970	2,337		
Groupers			1,166	44		
Jewfish			17,150	664		
Kingfish or "king mackerel"			4,300	204		
King whiting or "kingfish"	537	21	4,800	192		
Pompano	590	78	3,572	815		
Sea bass			450	21		
Sheepshead, salt-water	2,077	166	12,754	625		
Sheepshead, fresh-water	300	36				
Snapper, red			61,420	6,142		
Snook or sergeantfish	300	30	32,300	3,030		
Spanish mackerel	118	18	47,500	4,100		
Squeteagues or "sea trout"	58,739	7,242	205,655	23,798		
Shrimp	227,135	7,949	1,655,301	49,658		
Oysters, market, public	608,468	39,183	173,929	16,151		
Total	999,248	62,137	2,920,041	149,228	10,000	1,000

Species	Refugio		San Patricio	
	Pounds	*Value*	*Pounds*	*Value*
Buffalofish	2,500	$125		
Catfish	4,000	160	2,700	$81
Croaker	100	4	1,650	91
Drum, black	700	28	55,794	2,232
Drum, red, or redfish	8,000	800	89,950	9,813
Flounders			3,216	386
Jewfish			4,166	250
Kingfish or "king mackerel"			7,000	280
King whiting or "kingfish"			4,375	219
Mullet			150	7
Pompano			2,335	584
Sheepshead, salt-water	100	6	2,584	155
Snook or sergeantfish	200	20	13,700	1,504
Spanish mackerel			20,000	2,000
Squeteagues or "sea trout"	3,000	360	55,400	6,573
Shrimp			1,453,219	43,597
Oysters, market, public	7,000	750		
Total	25,600	2,253	1,716,239	67,772

INDUSTRIES RELATED TO THE FISHERIES

Wholesale trade.—There were 61 establishments along the coast of Texas engaged chiefly in handling fresh and frozen products. This is 24 per cent of the total number of such establishments in the Gulf section. These establishments employed 401 persons, who received $217,303 in salaries and wages. Nueces and Calhoun Counties were each represented by 13 wholesale establishments. Galveston County ranked next with 11 establishments.

Prepared and by-products trade.—There were 9 establishments on the coast of Texas in 1928 engaged primarily in the manufacture of prepared fishery products or by-products. This is 9 per cent of the total number in the Gulf section. They employed 133 persons who received $93,616 in salaries and wages. The products manufactured, consisting principally of canned shrimp, were valued at $330,008. Detailed statistics of most of the items manufactured may be obtained from Fishery Industries of the United States, 1928. Bureau of Fisheries Document No. 1067.

Industries related to the fisheries of Texas, 1928

WHOLESALE FISHERY TRADE

Items	Aransas	Calhoun	Cameron	Galveston	Harris, Chambers, and Orange	Matagorda	Nueces	San Patricio	Total
Establishments	4	13	6	11	4	6	13	4	61
Persons engaged:									
Proprietors	4	19	7	20	4	6	17	6	83
Salaried employees	4	7	15	16		5	9	2	58
Wage earners	15	47	25	57	6	53	45	12	260
Paid to salaried employees	$5,440	$10,991	$18,200	$28,880		$5,810	$14,340	$5,436	$89,097
Paid to wage earners	7,899	21,356	13,866	33,801	$4,040	23,256	18,332	5,656	128,206
Total salaries and wages	13,339	32,347	32,066	62,681	4,040	29,066	32,672	11,092	217,303

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS

Items	Number	Products [1]	Quantity	Value
Establishments	9	Canned shrimp:		
Persons engaged:		Dry pack, standard cases [2]	6,685	$39,315
Proprietors	16	Wet pack, standard cases	32,686	227,824
Salaried employees	11	Poultry feed from crushed oyster shells, tons	2,889	24,747
Wage earners	106	Other products [3]		38,122
Paid to salaried employees	$34,492	Total		330,008
Paid to wage earners	59,124			
Total salaries and wages	93,616			

[1] Includes canned shrimp prepared by one firm, whose activities were principally in the wholesale fishery trade.
[2] A standard case contains forty-eight 5-ounce cans in the dry pack or forty-eight 5¾-ounce cans in the wet pack of shrimp.
[3] Includes canned oysters and lime from crushed oyster shells.

HISTORICAL REVIEW

Twelve general surveys have been made for statistics of the Gulf States during the 49 years from 1880 to 1928. The catch for 1928, which amounted to 191,007,000 pounds, was greater than that in any year during the period 1880 to 1928, except that in 1927 which amounted to 195,705,000 pounds. Beginning with a catch of 23,561,000 pounds in 1880, there has been an almost continuous increase throughout the period. Comparative statistics for the catch of each of the more important species are shown in the following tables.

Fisheries of the Gulf States, 1880 to 1928

[Expressed in thousands of pounds and thousands of dollars; that is, 000 omitted]

Year	Florida (west coast)		Alabama		Mississippi	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
1880	8,376	565	3,542	119	788	23
1887	(1)	(1)	(1)	(1)	6,548	190
1888	19,597	802	1,634	76	7,883	232
1889	23,597	949	4,560	147	8,933	251
1890	27,419	1,064	4,777	155	8,131	246
1897	28,255	945	4,699	134	7,830	192
1902	48,120	1,462	9,351	267	23,427	553
1908	37,566	2,120	10,665	387	17,302	459
1918	54,754	3,420	5,609	231	20,592	763
1923	73,266	4,026	7,631	342	25,032	986
1927	73,835	4,351	10,076	437	34,503	1,259
1928	61,121	3,866	14,466	587	30,701	1,060

Year	Louisiana		Texas		Total	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
1880	6,996	393	3,859	128	23,561	1,228
1887	18,455	580	6,282	256	(1)	(1)
1888	19,121	613	6,609	271	54,844	1,994
1889	20,947	621	7,358	297	65,395	2,265
1890	20,789	660	7,959	314	69,075	2,439
1897	17,402	714	7,175	287	65,361	2,272
1902	24,754	858	8,044	354	113,696	3,494
1908	42,302	1,448	10,439	446	118,274	4,860
1918	24,954	1,419	25,015	677	130,924	6,510
1923	34,835	1,961	19,560	782	160,324	8,097
1927	56,208	2,863	21,083	1,054	195,705	9,964
1928	69,507	3,478	15,212	875	191,007	9,866

CATCH OF CERTAIN SPECIES: BY STATES

[Expressed in thousands of pounds; that is, 000 omitted]

Year	Bluefish						Cero and kingfish or "king mackerel"			
	Florida (west coast)	Alabama	Mississippi	Louisiana	Texas	Total	Florida (west coast)	Mississippi	Texas	Total
1880	44									
1887	(1)	(1)	73	13	7		(1)			
1888	(1)		78	15	6		(1)			
1889	364	58	90	13	24	549	456			456
1890	420	56	96	13	26	611	292			292
1897	265					265	440			440
1902	353					353	152			152
1908	580					580	37			37
1918	271					271	466			466
1923	418					418	564			564
1927	620	46	30	6	1	703	1,253		10	1,263
1928	390	31	27		1	449	1,315	1	11	1,327

[1] Figures not available.

Fisheries of the Gulf States, 1880 to 1928—Continued

CATCH OF CERTAIN SPECIES: BY STATES—Continued

[Expressed in thousands of pounds; that is, 000 omitted]

Year	Crevalle [2]					Croaker					
	Florida (west coast)	Alabama	Mississippi	Texas	Total	Florida (west coast)	Alabama	Mississippi	Louisiana	Texas	Total
1887	(1)	(1)	--------	63	--------	(1)	(1)	[3] 75	[3] 54	107	--------
1888	(1)	--------	--------	60	--------	(1)	--------	[3] 79	[3] 55	110	--------
1889	185	44	--------	52	281	36	103	54	150	148	491
1890	333	41	--------	56	430	43	98	57	158	176	532
1897	46	--------	--------	--------	46	--------	(1)	(1)	(1)	(1)	--------
1902	85	--------	--------	--------	85	--------	58	273	155	58	544
1908	227	--------	--------	--------	227	--------	72	176	569	159	776
1918	561	--------	--------	--------	561	--------	94	41	383	198	716
1923	508	--------	--------	--------	508	--------	37	45	219	68	369
1927	907	4	--------	--------	911	45	27	51	186	104	368
1928	496	28	6	1	531	42	46	56	169	85	398

Year	Drum, black						Drum, red, or redfish					
	Florida (west coast)	Alabama	Mississippi	Louisiana	Texas	Total	Florida (west coast)	Alabama	Mississippi	Louisiana	Texas	Total
1887	(1)	(1)	2	--------	--------	--------	(1)	(1)	141	289	1,005	------
1888	(1)	------	2	--------	--------	--------	(1)	------	165	288	944	------
1889	102	7	2	11	4	126	393	64	185	314	1,063	2,019
1890	122	7	3	18	4	154	458	54	201	339	1,108	2,160
1897	38	6	5	19	50	118	236	213	199	465	1,144	2,257
1902	194	5	12	51	157	419	1,104	70	93	442	898	2,607
1908	--------	------	--------	--------	--------	--------	[4] 608	[4] 151	[4] 244	[4] 716	[4] 1,309	3,028
1918	57	12	14	54	1,873	2,010	958	23	116	566	1,337	3,000
1923	95	9	39	60	1,028	1,231	1,398	15	177	665	878	3,133
1927	70	10	95	182	1,432	1,789	776	55	237	556	1,248	2,872
1928	39	8	63	163	996	1,269	889	49	208	434	1,030	2,610

Year	Grouper						Menhaden		
	Florida (west coast)	Alabama	Mississippi	Louisiana	Texas	Total	Florida (west coast)	Texas	Total
1880	1,764	--------	--------	--------	--------	--------	--------	--------	--------
1887	(1)	(1)	--------	--------	4	--------	(1)	--------	--------
1888	(1)	--------	--------	--------	7	--------	(1)	--------	--------
1889	418	10	--------	18	--------	446	--------	--------	--------
1890	399	11	--------	18	--------	428	--------	--------	--------
1897	781	69	--------	--------	3	853	--------	--------	--------
1902	437	655	--------	--------	40	1,112	2	--------	2
1908	1,231	394	--------	--------	--------	1,625	--------	--------	--------
1918	5,626	244	25	20	21	5,936	295	14,118	14,413
1923	4,266	305	26	10	33	4,640	10,956	8,517	19,473
1927	4,488	144	38	16	37	4,723	13,466	--------	13,466
1928	3,971	199	49	--------	22	4,241	5,857	--------	5,857

[1] Figures not available.
[2] Includes blue runner or jurel.
[3] Includes spots.
[4] Probably includes some black drum.

NOTE.—Prior to 1889 some of the above species were included under the heading "Miscellaneous fish" or "All other species"; therefore, the total for certain species is not shown for certain years of this period.

Fisheries of the Gulf States, 1880 to 1928—Continued

CATCH OF CERTAIN SPECIES: BY STATES—Continued

[Expressed in thousands of pounds; that is, 000 omitted]

Year	Mullet						Pompano					
	Florida (west coast)	Alabama	Mississippi	Louisiana	Texas	Total	Florida (west coast)	Alabama	Mississippi	Louisiana	Texas	Total
1880	2,028	125	2	55	8	2,218	14	------	------	------	------	------
1887	(1)	(1)	233	253	31	------	(1)	(1)	11	30	2	------
1888	(1)	262	233	253	32	------	(1)	------	12	31	2	------
1889	13,348	613	722	283	82	15,048	420	18	14	29	2	483
1890	15,556	588	305	288	83	16,820	342	17	15	32	2	408
1897	15,575	600	241	166	------	16,582	406	------	------	------	------	406
1902	26,310	1,546	603	123	------	28,582	487	------	------	------	------	487
1908	16,145	1,656	1,035	133	------	18,969	232	------	------	------	------	232
1918	26,380	1,703	1,565	325	------	29,973	242	------	------	------	------	242
1923	28,454	648	1,739	181	------	31,022	282	------	------	------	------	282
1927	24,802	1,973	2,363	132	5	29,275	428	5	6	10	5	454
1928	23,489	2,118	803	24	14	26,448	419	5	4	2	11	441

Year	Sheepshead						Snapper, red					
	Florida (west coast)	Alabama	Mississippi	Louisiana	Texas	Total	Florida (west coast)	Alabama	Mississippi	Louisiana	Texas	Total
1880	------	------	------	------	------	------	223	360	------	900	------	------
1887	(1)	(1)	124	362	695	------	(1)	(1)	------	131	75	------
1888	(1)	------	128	366	647	------	(1)	86	------	150	65	------
1889	527	33	156	364	739	1,819	3,469	51	------	250	22	3,792
1890	544	35	173	391	779	1,922	4,173	62	------	240	5	4,480
1897	663	87	110	238	468	1,566	5,314	335	------	------	465	6,114
1902	1.374	75	70	339	217	2.075	8,074	3,466	------	------	2,068	13,608
1908	473	24	81	249	298	1,125	7,659	2,635	------	------	2,252	12,546
1918	989	28	68	277	198	1,560	7,230	798	98	60	1,243	9,429
1923	1,025	21	91	193	141	1,471	9,471	970	104	175	1,009	11,729
1927	680	47	144	183	48	1,102	9,313	1,059	219	72	1,237	11.900
1928	499	38	80	108	55	780	7,891	1,301	97	48	1,055	10,392

Year	Spanish mackerel						Squeteagues or "sea trout"					
	Florida (west coast)	Alabama	Mississippi	Louisiana	Texas	Total	Florida (west coast)	Alabama	Mississippi	Louisiana	Texas	Total
1887	(1)	(1)	30	119	11	------	(1)	(1)	258	524	941	------
1888	(1)	------	34	126	11	------	(1)	228	280	522	872	------
1889	382	58	44	134	17	635	712	205	370	619	1,077	2,983
1890	448	44	46	144	25	707	654	209	372	656	1,120	3,011
1897	503	86	65	56	41	751	830	296	453	567	1,012	3,158
1902	1,513	34	7	6	64	1,624	1,913	259	473	1,078	1,119	4,842
1908	1,419	13	7	5	42	1,446	1,207	208	517	1,103	1,055	4,090
1918	3,463	4	12	2	41	3,522	1,694	139	356	1,190	1,613	4,992
1923	3,772	1	10	3	79	3,795	1,591	49	410	783	1,524	4,357
1927	4,570	22	12	23	144	4,771	2,583	118	605	822	1,700	5,828
1928	3,229	4	9	22	88	3,352	2,683	125	487	885	1,160	5,340

1 Figures not available.

Fisheries of the Gulf States, 1880 to 1928—Continued

CATCH OF CERTAIN SPECIES: BY STATES—Continued

[Expressed in thousands of pounds; that is, 000 omitted]

Year	Sturgeon			Crabs					
	Florida (west coast)	Alabama	Total	Florida (west coast)	Alabama	Mississippi	Louisiana	Texas	Total
1880	-------	-------	-------	-------	-------	-------	288	36	-------
1887	[1]	[1]	-------	[1]	[1]	53	971	111	-------
1888	[1]	-------	-------	[1]	96	57	994	115	-------
1889	-------	-------	-------	-------	-------	67	989	189	1,245
1890	-------	-------	-------	-------	-------	47	981	191	1,219
1897	9	-------	9	6	24	153	1,459	138	1,780
1902	349	-------	349	13	75	265	1,312	43	1,708
1908	7	-------	7	64	246	427	322	200	1,259
1918	5	-------	5	24	96	225	282	194	821
1923	7	-------	7	7	84	443	316	109	959
1927	8	15	23	70	32	2,434	1,227	121	3,884
1928	16	10	26	84	105	1,584	2,503	301	4,577

Year	Shrimp					
	Florida (west coast)	Alabama	Mississippi	Louisiana	Texas	Total
1880	-------	-------	-------	534	638	-------
1887	-------	[1]	1,145	6,810	255	-------
1888	[1]	44	1,093	6,943	259	-------
1889	-------	30	794	7,238	242	8,304
1890	-------	-------	614	6,662	176	7,452
1897	-------	41	1,903	4,487	361	6,792
1902	17	-------	4,424	7,635	291	12,350
1908	8	37	4,121	8,581	118	12,865
1918	3,250	1,266	9,147	18,520	164	32,347
1923	2,881	3,182	9,879	27,753	3,422	47,117
1927	2,389	5,162	9,234	40,259	11,832	68,876
1928	2,877	5,972	11,768	53,779	7,774	82,170

Year	Sea crawfish or spiny lobster	Oysters [5]						Sponges
	Florida (west coast)	Florida (west coast)	Alabama	Mississippi	Louisiana	Texas	Total	Florida (west coast)
1880	-------	410	732	175	2,065	669	-------	207
1887	[1]	[1]	[1]	4,068	4,748	1,793	-------	[1]
1888	[1]	[1]	533	5,370	5,040	2,389	-------	254
1889	-------	2,064	3,069	5,919	5,849	2,524	19,425	317
1890	-------	2,598	3,367	5,645	5,891	3,086	20,587	367
1897	158	1,258	1,785	4,408	6,714	2,491	16,656	333
1902	56	4,057	2,432	16,836	8,389	2,402	34,116	347
1908	53	3,764	4,132	7,473	25,554	3,480	44,403	545
1911	-------	1,312	3,093	4,604	31,530	3,043	43,582	[1]
1918	322	2,616	1,032	8,907	7,855	3,344	23,754	452
1923	321	1,642	2,262	11,875	7,155	2,520	25,454	575
1927	131	1,736	1,165	18,815	11,534	2,763	36,013	600
1928	197	2,859	4,218	15,210	10,849	1,807	34,943	554

[1] Figures not available.
[5] Shown on the basis of 7 pounds of meat to the bushel.

FISHERIES OF THE PACIFIC COAST STATES

During 1928 the catch of fishery products in the Pacific Coast States exceeded that in any year for which there are records. The value of the catch, however, was somewhat less than during several of the past few years. These fisheries gave employment to 19,733 fishermen or 4 per cent less than in 1927. Of the total number of fishermen employed during 1928, 5,242 were engaged on vessels and 14,491 were employed in the shore and boat fisheries. Their catch amounted to 693,484,447 pounds valued at $20,512,772. This is an increase of 6 per cent in the quantity and a decrease of 8 per cent in the value as compared with the catch and its value for 1927. Of the total catch in 1928, 674,898,970 pounds, valued at $18,652,473, were fish; 13,704,838 pounds, valued at $1,564,299, were shellfish and miscellaneous products; and 4,880,639 pounds, valued at $296,000, were whale products.

Based on the value to the fishermen, salmon with a production of 80,891,735 pounds, valued at $7,578,148, was by far the most important fishery product taken on the Pacific coast. Pilchard or sardine ranked second with a production of 420,269,855 pounds, valued at $2,323,925. Other important species were yellowfin tuna, with a production of 32,251,246 pounds, valued at $1,773,788, and halibut with a production of 12,729,214 pounds, valued at $1,476,190. Other products were valued individually at less than $1,000,000.

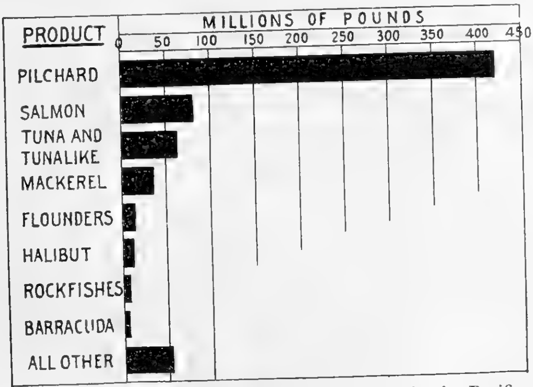

FIGURE 24.—Yield of principal fishery products in the Pacific Coast States, 1928

The industries related to the fisheries of the Pacific Coast States gave employment to 11,034 persons of whom 356 were engaged in transporting fishery products, 1,216 were in the wholesale trade and received $2,117,050 in salaries and wages, and 9,462 were in the prepared-products and by-products trade and received $6,006,618 in salaries and wages.

There were 109 establishments in the wholesale fish trade handling primary products and 166 establishments in the prepared-products and by-products trade. The latter manufactured products, valued at $37,412,423, consisting principally of salmon, sardines, and tuna and tunalike fishes.

Fisheries of the Pacific Coast States, 1928

SUMMARY OF CATCH

Products	Washington		Oregon		California		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Fish	78, 791, 362	$6, 717, 793	26, 711, 897	$2, 608, 804	569, 395, 711	$9, 325, 876	674, 898, 970	$18, 652, 473
Shellfish, etc	4, 083, 136	783, 006	761, 914	77, 524	8, 859, 788	703, 769	13, 704, 838	1, 564, 299
Whale products					4, 880, 639	296, 000	4, 880, 639	296, 000
Total	82, 874, 498	7, 500, 799	27, 473, 811	2, 686, 328	583, 136, 138	10, 325, 645	693, 484, 447	20, 512, 772

OPERATING UNITS: BY STATES

Items	Washington				Oregon		
	Puget Sound district	Coastal district	Columbia River district	Total	Columbia River district	Coastal district	Total
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	2, 170	8	2	2, 180	70	25	95
On boats and shore	2, 186	2, 888	1, 543	6, 617	2, 379	1, 618	3, 997
Total	4, 356	2, 896	1, 545	8, 797	2, 449	1, 643	4, 092
Vessels:							
Steam	2			2			
Net tonnage	16			16			
Motor	341	4	1	346	23	9	32
Net tonnage	6, 418	24	5	6, 447	216	81	297
Sail	4			4			
Net tonnage	1, 384			1, 384			
Total vessels	347	4	1	352	23	9	32
Total net tonnage	7, 818	24	5	7, 847	216	81	297
Boats:							
Motor	1, 154	295	917	2, 366	1, 222	921	2, 143
Other	319	228	270	817	65	339	404
Apparatus:							
Purse seines—							
Salmon	168			168			
Yards	100, 300			100, 300			
Haul seines	103		50	153	54	2	56
Yards	9, 995		27, 493	37, 488	31, 140	400	31, 540
Drift gill nets, salmon	340	116	465	921	927	533	1, 460
Square yards	629, 074	264, 200	1, 114, 880	2, 008, 154	2, 976, 330	540, 813	3, 517, 143
Set gill nets, salmon	16	185	346	547	205	802	1, 007
Square yards	5, 910	86, 148	84, 320	176, 378	62, 630	156, 956	219, 586
Troll lines	3, 720	35	748	4, 503	1, 134	884	2, 018
Hooks	8, 814	70	1, 576	10, 460	3, 244	2, 304	5, 548
Trawl, set and hand lines	27, 742	52	47	27, 841	246	210	456
Hooks	565, 136	6, 300	4, 225	575, 661	32, 000	29, 400	61, 400
Pound nets	180	184	304	668	70		70
Brush weirs	12			12			
Fish wheels			30	30			
Dip nets			143	143	188		188
Drag bag nets	45			45			
Yards	3, 878			3, 878			
Reef nets	8			8			
Beam trawls	36			36			
Yards at mouth	221			221			
Traps—							
Crab	2, 340	3, 850		6, 190		3, 660	3, 660
Crawfish					920		920
Tongs and dredges	79	35		114		2	2
Shovels	262	2, 478		2, 740		230	230

Fisheries of the Pacific Coast States, 1928—Continued

OPERATING UNITS: BY STATES—Continued

Items	California						Grand total
	Northern district	San Francisco district	Monterey district	Southern district: San Pedro division	Southern district: San Diego division	Total	
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:							
On vessels	46	285	90	1,877	669	2,967	5,242
On boats and shore	502	1,025	1,030	1,025	295	3,877	14,491
Total	548	1,310	1,120	2,902	964	6,844	19,733
Vessels:							
Steam		4				4	6
Net tonnage		241				241	257
Motor	15	26	10	257	119	427	805
Net tonnage	153	407	110	4,889	2,883	8,442	15,186
Sail		4				4	8
Net tonnage		1,598				1,598	2,982
Total vessels	15	34	10	257	119	435	819
Total net tonnage	153	2,246	110	4,889	2,883	10,281	18,425
Boats:							
Motor	144	643	276	499	157	1,719	6,228
Other	239	52	13	52	12	368	1,589
Apparatus:							
Purse seines—							
Barracuda				48		48	48
Yards				20,320		20,320	20,320
Salmon							168
Yards							100,300
Sardine			3	71		74	74
Yards			930	27,570		28,500	28,500
Tuna				62		62	62
Yards				34,133		34,133	34,133
Haul seines	2	8				10	219
Yards	400	960				1,360	70,388
Drift gill nets, salmon	198	233				431	2,812
Square yards	129,200	573,646				702,846	6,228,143
Set gill nets, salmon							1,554
Square yards							395,964
Gill nets—							
Barracuda				66	26	92	92
Square yards				430,244	145,647	575,891	575,891
Crab			24			24	24
Square yards			57,810			57,810	57,810
Sea bass		17	20	48	22	107	107
Square yards		25,646	30,861	259,766	102,870	419,143	419,143
Shad		241				241	241
Square yards		576,954				576,954	576,954
Striped bass		173				173	173
Square yards		364,338				364,338	364,338
Other	22	29	70	26	14	161	161
Square yards	10,860	24,640	47,320	18,798	10,500	112,118	112,118
Trammel nets				51	20	71	71
Square yards				365,766	248,770	614,536	614,536
Troll lines	706	982	535	2,693	1,598	6,514	13,035
Hooks	3,298	4,902	2,666	2,693	1,598	15,157	31,165
Trawl, set and hand lines	199	446	990	1,351	719	3,705	32,002
Hooks	23,750	36,168	181,720	292,978	142,969	677,585	1,314,646
Pound nets							738
Brush weirs							12
Fish wheels							30
Fyke nets		1,248				1,248	1,248
Dip nets	29					29	360
Bag nets, shrimp		8				8	8
Yards		4,272				4,272	4,272
Drag bag nets							45
Yards							3,878
Reef nets							8
Lampara nets—							
Sardine		16	60	102	44	222	222
Yards		3,776	20,354	39,830	12,858	76,818	76,818
Squid			40			40	40
Yards			10,120			10,120	10,120
Paranzella nets	1	11	1	5		18	18
Yards at mouth	17	183	17	84		301	301
Beam trawls		24				24	60
Yards at mouth		148				148	366

Fisheries of the Pacific Coast States, 1928—Continued

OPERATING UNITS: BY STATES—Continued

Items	California						Grand total
	Northern district	San Francisco district	Monterey district	Southern district		Total	
				San Pedro division	San Diego division		
Apparatus—Continued.							
Traps—	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Crab	476	4,080	35			4,591	14,441
Crawfish							920
Lobster				2,644	2,190	4,834	4,834
Octopus			22			22	22
Harpoons—							
Whale		4				4	4
Swordfish				24	47	71	71
Turtle					4	4	4
Tongs and dredges		6				6	122
Rakes		2	2			4	4
Shovels	6	16	5	158		185	3,155
Abalone outfits			11	7		18	18

CATCH: BY STATES

Species	Washington		Oregon	
FISH	*Pounds*	*Value*	*Pounds*	*Value*
Carp	556,856	$22,274	12,500	$500
Cod, dry salted	2,884,800	144,390		
Cod tongues	14,000	1,400		
Flounders:				
"Sole"	222,849	6,685	84	1
Other	123,650	2,473		
Grayfish	3,203	16		
Halibut	11,927,858	1,383,823	425,610	52,610
Herring	1,536,570	15,369	190	2
"Lingcod"	996,747	35,952	62,210	2,471
Perch	75,395	4,469	3,120	146
Pilchard or sardine			190	4
Rockfishes	617,563	22,079	73,702	3,281
Sablefish	2,335,163	110,525	279,880	11,570
Salmon	53,838,342	4,773,273	22,574,827	2,324,164
Shad	515,423	9,103	1,344,230	40,327
Skates	1,946	20		
Smelt	1,405,429	28,108	19,148	870
Steelhead trout	1,631,741	150,524	1,814,480	163,303
Striped bass			12,897	1,560
Sturgeon	84,234	6,739	88,829	7,995
Other fish	19,593	571		
Total	78,791,362	6,717,793	26,711,897	2,608,804
SHELLFISH, ETC.				
Crabs	1,521,392	95,145	492,811	33,601
Crawfish			158,200	19,775
Shrimp	36,487	4,378		
Clams:				
Hard	215,131	32,278		
Razor	1,535,136	298,499	100,769	19,594
Mixed			9,702	4,074
Octopus	63,227	3,161		
Oysters:				
Eastern market	73,640	31,914		
Native market	614,520	312,594	432	480
Scallops	17,528	4,733		
Trepang or sea cucumber	6,075	304		
Total	4,083,136	783,006	761,914	77,524
Grand total	82,874,498	7,500,799	27,473,811	2,686,328

Fisheries of the Pacific Coast States, 1928—Continued

CATCH: BY STATES—Continued

Species	California[1] Pounds	California[1] Value	Total Pounds	Total Value
FISH				
Albacore	283, 321	$42, 324	283, 321	$42, 324
Anchovies	357, 470	4, 016	357, 470	4, 016
Barracuda	6, 452, 456	505, 838	6, 452, 456	505, 838
Bonito	2, 088, 333	67, 977	2, 088, 333	67, 977
Carp	157, 283	2, 501	726, 639	25, 275
Catfish	458, 392	63, 569	458, 392	63, 569
Cod, dry salted	2, 596, 670	146, 634	5, 481, 470	291, 024
Cod tongues	8, 000	1, 200	22, 000	2, 600
Eels	227	5	227	5
Flounders:				
"California halibut"	1, 187, 651	161, 774	1, 187, 651	161, 774
"Sole"	10, 280, 419	471, 519	10, 503, 352	478, 205
Other	1, 517, 098	79, 432	1, 640, 748	81, 905
Grayfish	623, 816	13, 275	627, 019	13, 291
Hake	108, 648	2, 173	108, 648	2, 173
Halibut	375, 746	39, 757	12, 729, 214	1, 476, 190
Hardhead	61, 699	6, 922	61, 699	6, 922
Herring	1, 139, 682	11, 814	2, 676, 442	27, 185
Horse mackerel	540, 352	18, 198	540, 352	18, 198
Kingfish	441, 758	12, 087	441, 758	12, 087
"Lingcod"	849, 056	32, 560	1, 908, 013	70, 983
Mackerel	35, 262, 494	617, 317	35, 262, 494	617, 317
Mullet	82, 739	8, 548	82, 739	8, 548
Perch	236, 934	12, 534	315, 449	17, 149
Pilchard or sardine	420, 269, 665	2, 323, 921	420, 269, 855	2, 323, 925
Pompano	30, 082	4, 433	30, 082	4, 433
Rock bass	625, 871	44, 132	625, 871	44, 132
Rockfishes	6, 419, 987	309, 900	7, 111, 252	335, 260
Sablefish	916, 955	37, 848	3, 531, 998	159, 943
Salmon	4, 478, 566	480, 711	80, 891, 735	7, 578, 148
Sculpin	99, 711	10, 047	99, 711	10, 047
Sea bass:				
Black	381, 705	19, 196	381, 705	19, 196
White or squeteague	1, 280, 738	165, 101	1, 280, 738	165, 101
Shad	2, 088, 878	69, 281	3, 948, 531	118, 711
Sheepshead	372, 677	15, 781	372, 677	15, 781
Skates	458, 926	9, 230	460, 872	9, 250
Skipjack or striped tuna	15, 814, 704	562, 216	15, 814, 704	562, 216
Smelt	916, 719	58, 534	2, 341, 296	87, 512
Splittail	10, 740	616	10, 740	616
Squawfish	3, 780	221	3, 780	221
Steelhead trout			3, 446, 221	313, 827
Striped bass	484, 113	74, 172	497, 010	75, 732
Stingray	3, 296	16	3, 296	16
Sturgeon			173, 063	14, 734
Suckers	1, 029	35	1, 029	35
Swordfish	426, 001	50, 903	426, 001	50, 903
Tomcod	11, 923	359	11, 923	359
Tuna:				
Bluefin	13, 700, 870	823, 401	13, 700, 870	823, 401
Yellowfin	32, 251, 246	1, 773, 788	32, 251, 246	1, 773, 788
Whitebait	135, 186	8, 854	135, 186	8, 854
Whitefish	222, 192	14, 371	222, 192	14, 371
Yellowtail	2, 683, 514	138, 978	2, 683, 514	138, 978
Other fish	196, 393	7, 857	215, 986	8, 428
Total	569, 395, 711	9, 325, 876	674, 898, 970	18, 652, 473
SHELLFISH, ETC.				
Crabs	3, 574, 734	290, 452	5, 588, 937	419, 198
Crawfish			158, 200	19, 775
Sea crawfish or spiny lobster	1, 076, 614	190, 469	1, 076, 614	190, 469
Shrimp	2, 280, 871	38, 269	2, 317, 358	42, 647
Abalone	420, 783	84, 953	420, 783	84, 953
Clams:				
Cockle	3, 020	2, 250	3, 020	2, 250
Hard			215, 131	32, 278
Pismo	31, 302	9, 502	31, 302	9, 502
Razor			1, 635, 905	318, 093
Soft	24, 855	10, 131	24, 855	10, 131
Mixed	6, 602	3, 331	16, 304	7, 405
Mussels	161	40	161	40
Octopus	6, 434	737	69, 661	3, 898
Oysters:				
Eastern market	72, 630	30, 699	146, 270	62, 613
Native market	4, 028	1, 726	618, 980	314, 800
Scallops			17, 528	4, 733

[1] Taken off California and off Latin America.

Fisheries of the Pacific Coast States, 1928—Continued

CATCH: BY STATES—Continued

Species	California		Total	
SHELLFISH, ETC.—continued	*Pounds*	*Value*	*Pounds*	*Value*
Squid	1,351,992	$40,740	1,351,992	$40,740
Terrapin	168	20	168	20
Trepang or sea cucumber			6,075	304
Turtles	5,594	450	5,594	450
Total	8,859,788	703,769	13,704,838	1,564,299
WHALE PRODUCT				
Whale oil	4,880,639	296,000	4,880,639	296,000
Grand total	583,136,138	10,325,645	693,484,447	20,512,772

Industries related to the fisheries of the Pacific Coast States, 1928

Items	Washington	Oregon	California	Total
Transporting:				
Persons engaged	218	55	83	356
Vessels—				
Steam			1	1
Net tonnage			331	331
Motor	74	29	18	121
Net tonnage	1,504	334	1,405	3,243
Sail			4	4
Net tonnage			1,520	1,520
Total vessels	74	29	23	126
Total net tonnage	1,504	334	3,256	5,094
Wholesale trade:				
Establishments	33	17	59	109
Persons engaged	494	102	620	1,216
Salaries and wages paid	$834,550	$129,447	$1,153,053	$2,117,050
Prepared products and by-products industries:				
Establishments	63	36	67	166
Persons engaged	1,793	929	6,740	9,462
Salaries and wages paid	$1,236,632	$822,616	$3,947,370	$6,006,618
Products	$7,757,405	$5,123,278	$24,531,740	$37,412,423

WASHINGTON

In 1928 Washington ranked second among the Pacific Coast States in the importance of its fisheries, employing 44 per cent of the total number of fishermen and accounting for 12 per cent of the total catch. There were 8,797 fishermen employed which is 1 per cent less than in 1927. Of the total number of fishermen, 2,180 were employed on fishing vessels and 6,617 in the shore and boat fisheries.

The catch amounted to 82,874,498 pounds, valued at $7,500,799. This is a decrease of 34 per cent in the catch and 18 per cent in the value of the catch as compared with the catch and its value for 1927. Of the total value of the catch, salmon accounted for 64 per cent; halibut, 18 per cent; oysters, 5 per cent; and clams, 4 per cent. Of the total catch, salmon accounted for 65 per cent; halibut, 14 per cent; sablefish and dry-salted cod, each, 3 per cent; and steelhead trout, herring, smelts, crabs, and clams, each, 2 per cent.

Operating units.—The catch of fishery products from Puget Sound, the coastal and Columbia River districts of Washington was taken by 8,797 fishermen, 2 steam vessels, 346 motor vessels, 4 sailing vessels, 3,183 motor and other small boats, and 14 major types of gear. The vessels had a combined net tonnage of 7,847 net tons.

Fisheries of Washington, 1928

Species	Puget Sound district		Coastal district		Columbia River district	
FISH	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp					556,856	$22,274
Cod, dry-salted	2,884,800	$144,390				
Cod tongues	14,000	1,400				
Flounders:						
"Sole"	222,849	6,685				
Other	123,650	2,473				
Grayfish	3,203	16				
Halibut	11,927,858	1,383,823				
Herring	1,536,170	15,361	400	$8		
"Lingcod"	996,747	35,952				
Perch	69,879	4,193	5,516	276		
Rockfishes	617,563	22,079				
Sablefish	2,335,163	110,525				
Salmon:						
Blueback or sockeye	4,347,952	837,233	157,092	18,851	167,200	30,096
Chinook	10,083,510	1,217,343	726,999	46,104	6,622,783	1,125,874
Chum	10,448,090	417,925	3,861,216	75,505	2,812,905	70,323
Humpback	1,260,502	42,734				
Silver	10,239,169	689,376	1,585,600	95,136	1,525,324	106,773
Shad					515,423	9,103
Skates	1,946	20				
Smelt	247,010	4,940			1,158,419	23,168
Steelhead trout	106,740	12,810	63,273	6,159	1,461,728	131,555
Sturgeon	2,268	180	20,700	1,656	61,266	4,903
Other fish	19,554	570	39	1		
Total	57,488,623	4,950,028	6,420,835	243,696	14,881,904	1,524,069
SHELLFISH						
Crabs	525,998	23,909	995,394	71,236		
Shrimp	36,487	4,378				
Clams:						
Hard	215,131	32,278				
Razor			1,535,136	298,499		
Octopus	63,227	3,161				
Oysters:						
Eastern market	50,000	18,750	23,640	13,164		
Native market	574,512	299,878	40,008	12,716		
Scallops	17,528	4,733				
Trepang or sea cucumber	6,075	304				
Total	1,488,958	387,391	2,594,178	395,615		
Grand total	58,977,581	5,337,419	9,015,013	639,311	14,881,904	1,524,069

PUGET SOUND DISTRICT

The Puget Sound district is comprised of Whatcom, Skagit, Snohomish, King, Pierce, Thurston, Mason, Kitsap, Island, and San Juan Counties and parts of Jefferson and Clallam Counties. The catch in this district in 1928 amounted to 58,977,581 pounds, valued at $5,337,419. Of the more important species comprising this catch, salmon amounted to 36,379,223 pounds, valued at $3,204,611; halibut 11,927,858 pounds, valued at $1,383,823; oysters 624,512 pounds, valued at $318,628; dry-salted cod 2,884,800 pounds, valued at $144,390; and sablefish 2,335,163 pounds, valued at $110,525.

Operating units.—The catch of fishery products in the Puget Sound district was taken by 4,356 fishermen who used 2 steam vessels, 341 motor vessels, 4 sailing vessels, 1,473 motor and other small boats, and 12 major types of gear. The vessels had a combined capacity of 7,818 net tons.

Catch by gear.—Three types of gear accounted for 91 per cent of the fishery products taken in the Puget Sound district during 1928. Listed in order of their importance they were, lines which accounted for 45 per cent of the catch, purse seines 24 per cent, and pound nets 22 per cent. The catch by lines was principally halibut, salmon, sablefish, and cod; and that by purse seines and pound nets was almost entirely salmon.

Fisheries of the Puget Sound district of Washington, 1928

OPERATING UNITS: BY GEAR

Items	Purse seines, salmon	Haul seines	Gill nets: Drift, salmon	Gill nets: Set, salmon	Troll lines	Trawl, set, and hand lines	Pound nets	Brush weirs
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	1,234	70	14		106	869		
On boats and shore	20	243	393	15	739	96	272	20
Total	1,254	313	407	15	845	965	272	20
Vessels:								
Motor	164	21	7		53	107		
Net tonnage	3,705	314	55		418	2,323		
Sail						4		
Net tonnage						1,384		
Total vessels	164	21	7		53	111		
Total net tonnage	3,705	314	55		418	3,707		
Boats:								
Motor	4	81	333		570	22	141	10
Other		70	5	15		44	84	8
Apparatus:								
Number	168	103	340	16	3,720	27,742	180	12
Length, yards	100,300	9,995						
Square yards			629,074	5,910				
Hooks					8,814	565,136		

Items	Drag bag nets	Reef nets	Beam trawls	Crab traps	Tongs	Shovels	Total, exclusive of duplication
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	12		40	4			2,170
On boats and shore	87	8	33	140	70	262	2,186
Total	99	8	73	144	70	262	4,356
Vessels:							
Steam			2				2
Net tonnage			16				16
Motor	4		17	2			341
Net tonnage	96		222	37			6,418
Sail							4
Net tonnage							1,384
Total vessels	4		19	2			347
Total net tonnage	96		238	37			7,818
Boats:							
Motor	37	3	17	115	6		1,154
Other	20	4			74		319
Apparatus:							
Number	45	8	36	2,340	79	262	
Length, yards	3,878						
Yards at mouth			221				

Fisheries of the Puget Sound district of Washington, 1928—Continued

CATCH: BY GEAR

Species	Purse seines		Haul seines		Drift gill nets		Set gill nets	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
FISH								
Flounders:								
"Sole"	35	$1	6,608	$198			5,844	$175
Other	18	1	13,165	263				
Herring			985,340	9,853				
"Lingcod"			2,660	96			3,161	61
Perch	300	18	55,151	3,309			1,260	76
Rockfishes	405	28	7,879	552			2,494	133
Salmon:								
Blueback or Sockeye	519,456	72,724	43,456	8,691	19,439	$2,777		
Chinook	267,295	18,711	19,008	2,281	686,290	82,355		
Chum	8,531,190	341,248	15,690	628	472,390	18,896	90	4
Humpback	1,229,666	41,809	380	11				
Silver	3,327,784	166,389	10,728	858	520,736	41,659	10,312	825
Skates			567	6				
Smelt			135,155	2,703			181	4
Steelhead trout	2,205	265			23,175	2,781		
Other fish	42	1	5,672	113				
Total	13,878,396	641,195	1,301,459	29,562	1,722,030	148,468	23,342	1,278
SHELLFISH, ETC.								
Octopus			263	13			2,425	121
Grand total	13,878,396	641,195	1,301,722	29,575	1,722,030	148,468	25,767	1,399

Species	Troll lines		Trawl lines		Set and hand lines		Pound nets	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
FISH								
Cod, dry salted			2,884,800	$144,390				
Cod, tongues			14,000	1,400				
Flounders:								
"Sole"							66	$2
Other					193	$4	3,468	69
Grayfish					3,000	15		
Halibut	8,558	$1,027	11,882,494	1,378,525	36,480	4,222	295	44
Herring							2,295	23
"Lingcod"	42,306	846	910,967	33,582	30,694	1,228	3,054	61
Perch					466	28	823	49
Rockfishes	2,339	70	576,476	20,054	4,155	279	18,031	558
Sablefish			9,335,163	110,525				
Salmon:								
Blueback or Sockeye	1,302	182					3,762,437	752,487
Chinook	4,744,379	590,011					4,365,746	523,890
Chum	70	3					1,427,080	57,083
Humpback	796	24					29,610	888
Silver	2,862,793	199,100					3,494,552	279,564
Skates					953	10	346	3
Steelhead trout	1,305	157					80,055	9,607
Sturgeon							2,268	180
Other fish	4,372	267			1,363	27	2,737	55
Total	7,668,220	791,687	18,603,900	1,688,476	77,304	5,813	13,192,863	1,624,563
SHELLFISH, ETC.								
Octopus					59,904	2,995	437	22
Grand total	7,668,220	791,687	18,603,900	1,688,476	137,208	8,808	13,193,300	1,624,585

Fisheries of the Puget Sound district of Washington, 1928—Continued

CATCH: BY GEAR—Continued

Species	Brush weirs		Drag bag nets		Reef nets		Beam trawls	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
FISH								
Flounders:								
"Sole"			127	$4			210,169	$6,305
Other			463	9			106,343	2,127
Grayfish							203	1
Halibut							31	5
Herring	514,000	$5,144	34,135	341				
"Lingcod"							3,905	78
Perch			11,849	711			30	2
Rockfishes							5,784	405
Salmon:								
Blueback or Sockeye					1,862	$372		
Chinook					792	95		
Chum					1,580	63		
Humpback					50	2		
Silver					12,264	981		
Skates							80	1
Smelt			111,674	2,233				
Other fish			868	17			4,500	90
Total	514,400	5,144	159,116	3,315	16,548	1,513	331,045	9,014
SHELLFISH, ETC.								
Shrimp							36,487	4,378
Octopus			55	3			143	7
Scallops							17,528	4,733
Trepang or sea cucumber							6,075	304
Total			55	3			60,233	9,422
Grand total	514,400	5,144	159,171	3,318	16,548	1,513	391,278	18,436

Species	Crab traps		Tongs		Shovels	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
SHELLFISH, ETC.						
Clams, hard					215,131	$32,278
Crabs	525,998	$23,909				
Oysters:						
Eastern market			50,000	$18,750		
Native market			574,512	299,878		
Total	525,998	$23,909	624,512	318,628	215,131	32,278

COASTAL DISTRICT

The coastal district is comprised of Grays Harbor County and parts of Jefferson, Clallam, and Pacific Counties. The catch in the coastal district amounted to 9,015,013 pounds, valued at $639,311. Considered according to value the important species comprising this catch were razor clams, 1,535,136 pounds of meats, valued at $298,499; salmon, 6,330,907 pounds, valued at $235,596; and crabs, 995,394 pounds, valued at $71,236.

Operating units.—The catch of fishery products in the coastal district of Washington during 1928 was taken by 2,896 fishermen who used 4 motor vessels, 523 motor and other small boats, and 6 major types of gear. The vessels had a combined capacity of 24 net tons.

Catch by gear.—Four types of gear accounted for 99 per cent of the fishery products taken in this district during 1928. In the order of their importance they were pound nets, which accounted for 37 per cent of the catch; gill nets, 36 per cent; shovels, 17 per cent; and crab traps, 11 per cent. The catch by pound nets and gill nets consisted almost entirely of salmon, that by shovels entirely razor clams, and that by crab traps exclusively crabs.

Fisheries of the coastal district of Washington, 1928

OPERATING UNITS: BY GEAR

Items	Gill nets		Troll lines	Set lines	Pound nets	Crab traps	Tongs and dredges	Shovels	Total, exclusive of duplication
	Drift, salmon	Set, salmon							
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:									
On vessels						4	4		8
On boats and shore	147	121	10	24	106	80	30	2,478	2,888
Total	147	121	10	24	106	84	34	2,478	2,896
Vessels, motor						2	2		4
Net tonnage						14	10		24
Boats:									
Motor	116	66	7	2	83	80	4		295
Other		116		22	82		11		228
Apparatus:									
Number	116	185	35	52	184	3,850	35	2,478	
Square yards	264,200	86,148							
Hooks			70	6,300					

CATCH: BY GEAR

Fish	Drift gill nets		Set gill nets		Troll and set lines		Pound nets	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Herring					400	$8		
Perch					5,516	276		
Salmon:								
Blueback or sockeye			157,092	$18,851				
Chinook	277,380	$16,643	149,975	11,752	253	16	299,391	$17,693
Chum	511,188	10,224	1,021,056	18,702			2,328,972	46,579
Silver	245,930	14,756	644,500	38,670	80	5	695,090	41,705
Steelhead trout	8,410	841	29,583	2,790			25,280	2,528
Sturgeon	19,200	1,536					1,500	120
Other fish							39	1
Total	1,062,108	44,000	2,002,206	90,765	6,249	305	3,350,272	108,626

Shellfish	Crab traps		Tongs and dredges		Shovels	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Crabs	995,394	$71,236				
Clams, razor					1,535,136	$298,499
Oysters:						
Eastern market			23,640	$13,164		
Native market			40,008	12,716		
Total	995,394	71,236	63,648	25,880	1,535,136	298,499

COLUMBIA RIVER DISTRICT

The Columbia River district is comprised of Wahkiakum, Cowlitz, Clarke, Skamania, Klickitat, Benton, Walla Walla, and Asotin Counties and part of Pacific County. The catch in this district amounted to 14,881,904 pounds, valued at $1,524,069. Considered according to value the more important species comprising this catch were salmon, 11,128,212 pounds, valued at $1,333,066; and steelhead trout, 1,461,728 pounds, valued at $131,555.

Operating units.—The catch of fishery products in the Columbia River district of Washington during 1928 was taken by 1,545 fishermen who used 1 motor vessel, 1,187 motor and other small boats, and 6 major types of gear. The motor vessel had a capacity of 5 net tons.

Catch by gear.—Four types of gear accounted for 92 per cent of the fishery products taken in this district during 1928. In the order of their importance they were, gill nets which accounted for 36 per cent of the catch; pound nets, 33 per cent; haul seines, 15 per cent; and dip nets, 8 per cent. The catch by gill nets, pound nets, and haul seines was principally salmon and that by dip nets was almost exclusively smelt.

Fisheries of the Columbia River district of Washington, 1928

OPERATING UNITS: BY GEAR

Items	Haul seines	Gill nets: Drift, salmon	Gill nets: Set, salmon	Troll lines	Set lines	Pound nets	Fish wheels	Dip nets	Total, exclusive of duplication
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels				2					2
On boats and shore	487	512	128	180	16	193	22	143	1,543
Total	487	512	128	182	16	193	22	143	1,545
Vessels, motor				1					1
Net tonnage				5					5
Boats:									
Motor	38	464	117	149	10	137		82	917
Other	59		96		8	124			270
Apparatus:									
Number	50	465	346	748	47	304	30	143	
Length, yards	27,493								
Square yards		1,114,880	84,320						
Hooks				1,576	4,225				

CATCH: BY GEAR

Species	Haul seines		Drift gill nets		Set gill nets		Troll lines	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp	556,856	$22,274						
Salmon:								
Blueback or sockeye	20,395	3,671	68,215	$12,279	11,390	$2,050		
Chinook	975,476	165,831	2,764,715	470,002	110,377	18,764	231,819	$39,409
Chum	95,580	2,390	1,538,982	38,475	44,496	1,112		
Silver	34,090	2,386	187,740	13,142	12,780	895	591,554	41,409
Shad	241,274	3,619	184,495	3,690	1,481	30		
Steelhead trout	241,840	21,766	320,670	28,860	120,290	10,826	458	41
Sturgeon	658	53	31,869	2,550	11,594	928		
Total	2,166,169	221,990	5,096,686	568,998	312,408	34,605	823,831	80,859

Species	Set lines		Pound nets		Fish wheels		Dip nets	
Salmon:	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Blueback or sockeye			36,720	$6,610	30,480	$5,486		
Chinook			2,273,780	386,543	266,041	45,227	575	$98
Chum			1,133,847	28,346				
Silver			699,070	48,935	70	5		
Shad			51,785	1,036	36,388	728	20	1
Smelt							1,158,419	23,168
Steelhead trout			742,760	66,848	35,640	3,208	70	6
Sturgeon	826	$66	8,448	676	7,871	630		
Total	826	66	4,946,410	538,994	376,490	55,284	1,159,084	23,273

INDUSTRIES RELATED TO THE FISHERIES

Transporting trade.—There were 218 persons engaged in Washington during 1928 in transporting the catch of fish. In this trade 74 motor vessels having a total capacity of 1,504 net tons were operated.

Wholesale trade.—There were 33 wholesale establishments in the Puget Sound, coastal, and Columbia River districts of Washington engaged chiefly in handling fresh and frozen products. This is 30 per cent of the total number of such establishments in the Pacific coast section. These establishments employed 494 persons, who received $834,550 in salaries and wages.

Prepared and by-products trade.—There were 63 establishments in Washington engaged primarily in the manufacture of prepared fishery products or by-products. This is 38 per cent of the total number in the Pacific coast section. They employed 1,793 persons who received $1,236,632 in salaries and wages. The products manufactured, consisting principally of canned and mild-cured salmon and canned clams, were valued at $7,757,405. Detailed statistics of most of the items manufactured may be obtained from Fishery Industries of the United States, 1928, Bureau of Fisheries Document 1067.

Industries related to the fisheries of Washington, 1928

TRANSPORTING

Items	Number
Men on transporting vessels	218
Transporting vessels, motor	74
Net tonnage	1,504

WHOLESALE FISHERY TRADE

Items	Puget Sound district	Columbia River and coastal districts	Total
Establishments	28	5	33
Persons engaged:			
Proprietors and salaried employees	137	7	144
Wage earners	329	21	350
Paid to salaried employees	$305,629	$11,500	$317,129
Paid to wage earners	501,214	16,207	517,421
Total salaries and wages	806,843	27,707	834,550

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS

Items	Number
Establishments	63
Persons engaged:	
Proprietors and salaried employees	259
Wage earners	1,534
Paid to salaried employees	$389,934
Paid to wage earners	846,698
Total salaries and wages	1,236,632

Products	Quantity	Value
Salted sablefish ... pounds	231,200	$27,744
Mild-cured:		
Chinook salmon ... do	3,584,625	1,254,619
Silver salmon ... do	400,950	128,304
Miscellaneous, salted and smoked fish		272,165
Canned:		
Salmon ... standard cases [1]	497,400	5,023,996
Razor clams—		
Whole ... do	5,871	51,434
Minced ... do	82,682	728,077
Hard clams—		
Whole ... do	12,452	55,273
Other clam products ... do	2,059	5,295
Shad ... do	6,756	33,789
Shad roe ... do	889	10,376
Salmon eggs ... do	3,970	99,455
Miscellaneous [2]		908
By-products [3]		65,970
Total		7,757,405

[1] A standard case contains forty-eight 1-pound cans of salmon, shad, shad roe, and salmon eggs or forty-eight No. 1 cans of clam products.
[2] Includes canned scallops, crabs, halibut fillets, and herring (for bait).
[3] Includes salmon oil and meal.

OREGON

In 1928 Oregon employed 21 per cent of the total number of fishermen and accounted for 4 per cent of the total catch of the Pacific coast section. There were 4,092 fishermen employed, which is 10 per cent less than in 1927. Of this total, 95 were employed on fishing vessels and 3,997 in the shore and boat fisheries. The catch amounted to 27,473,811 pounds valued at $2,686,328. This is a decrease of 20 per cent in the catch and 13 per cent in the value of the catch as compared with the catch and its value for 1927. Of the total value of the catch, salmon accounted for 87 per cent and steelhead trout, 6 per cent. Of the total production, salmon accounted for 82 per cent; steelhead trout, 7 per cent; and shad 5 per cent.

Operating units.—The catch of fishery products from the Columbia River and coastal districts of Oregon was taken by 4,092 fishermen, 23 motor vessels, 2,547 motor and other small boats, and 8 major types of gear. The vessels had a combined capacity of 216 net tons.

Fisheries of Oregon, 1928

Species	Columbia River district		Coastal district	
	Pounds	*Value*	*Pounds*	*Value*
FISH				
Carp	12,500	$500		
Flounders, "sole"			84	$1
Halibut	122,017	16,213	303,593	36,397
Herring			190	2
"Lingcod"	10,366	397	51,844	2,074
Perch			3,120	146
Pilchard			190	4
Rockfishes	56,872	2,608	16,830	673
Sablefish	112,564	4,877	167,316	6,693
Salmon:				
Blueback or sockeye	152,277	27,411		
Chinook	10,308,655	1,546,296	1,695,592	256,695
Chum	2,065,343	52,123	3,178,827	79,471
Silver	1,751,100	122,556	3,423,033	239,612
Shad	697,296	20,919	646,934	19,408
Smelt	10,000	500	9,148	370
Steelhead trout	1,130,579	101,752	683,901	61,551
Striped bass			12,897	1,560
Sturgeon	86,256	7,763	2,573	232
Total	16,515,825	1,903,915	10,196,072	704,889
SHELLFISH, ETC.				
Crabs			492,811	33,601
Crawfish	158,200	19,775		
Clams:				
Razor			100,769	19,594
Mixed			9,702	4,074
Oysters, native market			432	480
Total	158,200	19,775	603,714	57,749
Grand total	16,674,025	1,923,690	10,799,786	762,638

COLUMBIA RIVER DISTRICT

The Columbia River district is comprised of Columbia, Washington, Multnomah, Hood River, Wasco, Clackamas, Marion, Yamhill Counties and part of Clatsop County. The catch in this district amounted to 16,674,025 pounds, valued at $1,923,690. Considered according to value the more important species comprising this catch are salmon, 14,277,375 pounds, valued at $1,748,386; steelhead trout, 1,130,579 pounds, valued at $101,752; and shad, 697,296 pounds, valued at $20,919.

Operating units.—The catch of fishery products in the Columbia River district of Oregon during 1928 was taken by 2,449 fishermen, who used 23 motor vessels, 1,287 motor and other small boats, and 6 major types of gear. The combined capacity of the vessels amounted to 216 net tons.

Catch by gear.—Four types of gear accounted for 98 per cent of the fishery products taken in this district during 1928. Listed in order of their importance they were gill nets, which accounted for 60 per cent of the catch; haul seines, 20 per cent; lines, 14 per cent; and pound nets, 4 per cent. The catch by each of these gears was principally salmon and steelhead trout.

Fisheries of the Columbia River district of Oregon, 1928

OPERATING UNITS: BY GEAR

Items	Haul seines	Gill nets: Drift, salmon	Gill nets: Set, salmon	Troll lines	Trawl and set lines	Pound nets	Dip nets	Crawfish traps	Total, exclusive of duplication
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:									
On vessels				38	42				70
On boats and shore	672	1,441	84	225	12	51	188	46	2,379
Total	672	1,441	84	263	54	51	188	46	2,449
Vessels, motor				15	11				23
Net tonnage				128	108				216
Boats:									
Motor	42	927	81	184	12	34	12	46	1,222
Other	62		3						65
Apparatus:									
Number	54	927	205	1,134	246	70	188	920	
Length, yards	31,140								
Square yards		2,976,330	62,630						
Hooks				3,244	32,000				

CATCH: BY GEAR

Species	Haul seines: Pounds	Haul seines: Value	Gill nets: Pounds	Gill nets: Value	Troll lines: Pounds	Troll lines: Value
FISH						
Carp	12,500	$500				
Salmon:						
Blueback or sockeye	48,004	8,641	97,332	$17,520		
Chinook	2,385,271	357,791	6,875,216	1,031,280	726,789	$109,018
Chum	99,149	2,479	1,853,369	46,334	2,174	544
Silver	86,719	6,070	303,069	21,195	1,219,932	85,395
Shad	345,667	10,370	317,339	9,520		
Steelhead trout	434,835	39,135	486,397	43,776	1,670	150
Sturgeon	2,127	191	59,989	5,399		
Total	3,414,272	425,177	9,992,711	1,175,024	1,950,565	195,107

Species	Trawl and set lines: Pounds	Trawl and set lines: Value	Pound nets: Pounds	Pound nets: Value	Dip nets: Pounds	Dip nets: Value	Crawfish traps: Pounds	Crawfish traps: Value
FISH								
Halibut	122,017	$16,213						
"Lingcod"	10,366	397						
Rockfishes	56,872	2,608						
Sablefish	112,564	4,877						
Salmon:								
Blueback or sockeye			6,253	$1,126	688	$124		
Chinook			240,291	36,044	81,088	12,163		
Chum			106,487	2,662	4,164	104		
Silver			139,574	9,770	1,806	126		
Shad			34,290	1,029				
Smelt					10,000	500		
Steelhead trout			154,081	13,867	53,596	4,824		
Sturgeon	13,262	1,194	1,294	116	9,584	863		
SHELLFISH								
Crawfish							158,200	$19,775
Total	315,081	25,289	682,270	64,614	160,926	18,704	158,200	19,775

COASTAL DISTRICT

The coastal district is comprised of Tillamook, Lincoln, Lane, Douglas, Coos, Curry Counties, and part of Clatsop County. The catch in this district amounted to 10,799,786 pounds valued at $762,638. Considered according to value, the more important species were salmon, 8,297,452 pounds, valued at $575,778; steelhead trout, 683,901 pounds, valued at $61,551; and halibut, 303,593 pounds, valued at $36,397.

Operating units.—The catch of fishery products in the coastal district of Oregon during 1928 was taken by 1,643 fishermen, who used 9 motor vessels, 1,280 motor and other small boats, and 6 major types of gear. The combined capacity of the vessels was 81 net tons.

Catch by gear.—Two types of gear accounted for 95 per cent of the fishery products taken in this district during 1928. Listed in order of their importance they were gill nets, which accounted for 77 per cent, and lines 18 per cent. The catch by gill nets was principally salmon and that by lines principally salmon, halibut, and sablefish.

Fisheries of the coastal district of Oregon, 1928

OPERATING UNITS: BY GEAR

Items	Haul seines	Gill nets		Troll lines	Trawl and set lines	Crab traps	Tongs	Shovels	Total, exclusive of duplication
		Drift, salmon	Set, salmon						
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:									
On vessels				12	13				25
On boats and shore	6	684	499	193	20	179	2	230	1,618
Total	6	684	499	205	33	179	2	230	1,643
Vessels, motor				5	4				9
Net tonnage				37	44				81
Boats:									
Motor	2	523	181	139	10	179	1		921
Other	2	10	337				2		339
Apparatus:									
Number	2	533	802	884	210	3,660	2	230	
Length, yards	400								
Square yards		540,813	156,956						
Hooks				2,304	29,400				

CATCH: BY GEAR

Fish	Haul seines		Gill nets		Troll lines		Trawl and set lines	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Flounders, "sole"	84	$1						
Halibut							303,593	$36,397
Herring	190	2						
"Lingcod"							51,844	2,074
Perch	3,120	146						
Pilchard	190	4						
Rockfishes							16,830	673
Sablefish							167,316	6,693
Salmon:								
Chinook			1,459,962	$218,994	235,630	$37,701		
Chum			3,178,827	79,471				
Silver			2,305,455	161,382	1,117,578	78,230		
Shad			646,934	19,408				
Smelt	9,148	370						
Steelhead trout			683,199	61,488	702	63		
Striped bass			12,897	1,560				
Sturgeon			2,573	232				
Total	12,732	523	8,289,847	542,535	1,353,910	115,994	539,583	45,837

Fisheries of the coastal district of Oregon, 1928—Continued

CATCH: BY GEAR—Continued

Shellfish	Crab traps		Tongs		Shovels	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Crabs	492,811	$33,601				
Clams:						
Razor					100,769	$19,594
Mixed					9,702	4,074
Oysters, native market			432	$480		
Total	492,811	33,601	432	480	110,471	23,668

INDUSTRIES RELATED TO THE FISHERIES

Transporting trade.—There were 55 persons in Oregon during 1928 engaged in transporting the catch of fish. In this trade 29 motor vessels having a total capacity of 334 net tons were operated.

Wholesale trade.—There were 17 wholesale establishments in the Columbia River and coastal districts of Oregon engaged primarily in handling fresh and frozen products. This is 16 per cent of the total number of such establishments in the Pacific coast section. These establishments employed 102 persons, who received $129,447 in salaries and wages.

Prepared and by-products trade.—There were 36 establishments in Oregon during 1928 engaged primarily in the manufacture of prepared fishery products or by-products. This is 22 per cent of the total number in the Pacific coast section. They employed 929 persons, who received $822,616 in salaries and wages. The products manufactured, consisting principally of canned and mild-cured salmon, were valued at $5,123,278. Detailed statistics of most of the items manufactured may be obtained from Fishery Industries of the United States, 1928, Bureau of Fisheries Document No. 1067.

Industries related to the fisheries of Oregon, 1928

TRANSPORTING

Items	Number
Men on transporting vessels	55
Transporting vessels, motor	29
Net tonnage	334

WHOLESALE FISHERY TRADE

Items	Columbia River district	Coastal district	Total
Establishments	7	10	17
Persons engaged:			
Proprietors and salaried employees	13	13	26
Wage earners	42	34	76
Paid to salaried employees	$21,421	$22,681	$44,102
Paid to wage earners	46,360	38,985	85,345
Total salaries and wages	67,781	61,666	129,447

Industries related to the fisheries of Oregon, 1928—Continued

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS

Items	Number	Products	Quantity	Value
Establishments	36	Mild-cured:		
Persons engaged:		Chinook salmon.....pounds	1, 223, 475	$428, 216
Proprietors and salaried employees	124	Silver salmon.....do	1, 202, 850	276, 656
Wage earners	805	Canned:		
		Salmon.....standard cases [1]	342, 981	4, 187, 546
Paid to salaried employees	$241, 598	Shad.....do	9, 216	46, 317
Paid to wage earners	581, 018	Shad roe.....do	1, 799	63, 012
		Razor clam products—		
Total salaries and wages	822, 616	Whole.....do	369	3, 445
		Minced.....do	5, 109	46, 392
		Other products [2]		68, 694
		Total		5, 120, 278

[1] A standard case contains forty-eight 1-pound cans of salmon, shad, and shad roe, or forty-eight No. 1 cans of clam products.
[2] Includes canned salmon eggs (for bait), dried scrap and meal, and salmon oil.

CALIFORNIA

In 1928 California was by far the most important among the Pacific Coast States in regard to fisheries, employing 35 per cent of the total number of fishermen and accounting for 84 per cent of the total catch. There were 6,844 fishermen employed, which is 3 per cent less than in 1927. Of this number 2,967 were engaged on fishing vessels and 3,877 in the shore and boat fisheries.

The catch amounted to 583,136,138 pounds, valued at $10,325,645. This is an increase of 19 per cent in the catch and 3 per cent in the value of the catch as compared with the catch and its value for 1927. Of the total value of the catch, that for pilchard or sardine accounted for 23 per cent; yellowfin tuna, 17 per cent; bluefin tuna, 8 per cent; flounders, 7 per cent; mackerel, 6 per cent; and skipjack or striped tuna and barracuda, each, 5 per cent. Of the total production, pilchard or sardine accounted for 72 per cent; mackerel and yellowfin tuna, each, 6 per cent; skipjack or striped tuna, 3 per cent; and bluefin tuna and flounders, each, 2 per cent. Of the total catch, 530,760,185 pounds valued at $7,399,214 were taken off the coast of California. The remainder of the catch was taken off the coast of Latin America, except the salted cod which was taken in Alaska waters.

Operating units.—The catch of fishery products from the northern San Francisco, Monterey, and southern districts of California was taken by 6,844 fishermen, 4 steam vessels, 427 motor vessels, 4 sailing vessels, 2,087 motor and other small boats, and 17 major types of gear. The vessels had a combined capacity of 10,281 net tons.

Fisheries of California, 1928

CATCH: BY DISTRICTS

Species	Northern district		San Francisco district		Monterey district		Southern district—off California: San Pedro division	
FISH	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Albacore					180	$27	258,988	$38,674
Anchovies			125,515	$1,255	175,486	1,972	55,739	775
Barracuda					984	112	3,533,739	188,419
Bonito					706	38	636,644	20,537
Carp	74,894	$262	82,589	2,239				
Catfish	73,917	10,791	384,475	52,778				
Cod, dry salted			[1] 2,596,670	146,634				
Cod tongues			[1] 8,000	1,200				
Eels			5	1			222	4
Flounders:								
"California halibut"					21,667	2,677	776,684	104,251
"Sole"	222,041	8,807	7,958,700	358,174	1,810,944	90,647	280,051	12,818
Other	93,190	4,652	1,151,038	57,422	255,190	12,425	17,680	4,933
Grayfish	260	5	400,478	8,009	81,240	1,631	128,379	3,424
Hake			76,047	1,521	32,601	652		
Halibut	350,823	37,026	24,923	2,731				
Hardhead	11,090	39	50,609	6,883				
Herring	61,442	1,009	1,054,578	10,546	565	7	570	20
Horse mackerel					28,944	1,095	509,502	16,987
Kingfish			26,785	1,072	91,494	4,815	319,361	6,071
"Lingcod"	108,332	3,202	524,717	18,323	214,961	10,971	1,046	64
Mackerel			2,262	68	1,296,914	39,335	31,244,073	533,347
Mullet							5,495	531
Perch	41,465	1,472	86,996	2,723	24,062	1,163	77,353	6,802
Pilchard or sardine	87	4	26,965,736	144,837	221,568,278	1,220,958	164,619,004	909,095
Pompano					2,203	1,077	860	410
Rock bass							417,809	31,324
Rockfishes	107,264	2,661	998,258	47,627	2,286,344	89,207	1,800,147	99,882
Sablefish	385,185	15,126	342,029	15,391	183,068	6,790	6,673	541
Salmon	2,774,315	277,837	1,369,592	161,900	334,654	40,973	5	1
Sculpin					2,628	296	61,095	6,099
Sea bass:								
Black							66,096	3,843
White or squeteague			35,915	5,388	25,894	3,109	572,101	72,093
Shad			2,088,878	69,281				
Sheepshead							337,640	14,476
Skates	2,340	47	315,517	6,310	112,550	2,284	25,785	537
Skipjack or striped tuna					1,194	60	1,286,225	48,223
Smelt	63,161	3,876	113,706	9,524	171,502	13,295	543,492	30,136
Splittail			10,740	616				
Squawfish			3,780	221				
Striped bass			484,113	74,172				
Suckers			1,029	35				
Swordfish							103,805	13,254
Tomcod			11,798	354	125	5		
Tuna:								
Bluefin							11,592,489	689,930
Yellowfin							77,402	5,177
Whitebait	116,716	7,256	14,621	1,241	3,849	357		
Whitefish							103,720	8,367
Yellowtail							292,228	15,291
Other fish	6,756	135	30,014	889	20,542	572	121,423	5,234
Total	4,493,278	374,207	47,339,913	1,209,365	228,748,769	1,546,550	219,876,525	2,891,570
SHELLFISH, ETC.								
Crabs	86,088	7,174	3,014,760	251,230	473,616	32,038	270	10
Sea crawfish or spiny lobster							223,975	52,948
Shrimp			2,280,871	38,269				
Abalone					409,975	81,995	10,808	2,958
Clams:								
Cockle	34	11	2,986	2,239				
Pismo					539	162	30,763	9,340
Soft	95	24	24,642	10,054	20	7	98	46
Mixed	1,346	378	5,103	2,892	153	61		
Mussels			24	12	137	28		
Octopus			2,553	255	3,831	468	50	14
Oysters:								
Eastern, market			72,630	30,699				
Native, market			4,028	1,726				

[1] The catch of cod was made in Alaska waters.

Fisheries of California, 1928—Continued

CATCH: By districts—Continued

Species	Northern district		San Francisco district		Monterey district		Southern district—off California, San Pedro division	
SHELFISH, ETC.—contd.	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Squid					1, 351, 992	$40, 740		
Terrapin			168	$20				
Total	87, 563	$7, 587	5, 407, 765	337, 396	2, 240, 263	155, 499	265, 964	$65, 316
WHALE PRODUCT								
Whale oil			4, 880, 639	296, 000				
Grand total	4. 580, 841	381, 794	57, 628, 317	1, 842, 761	230, 989, 032	1, 702, 049	220, 142, 489	2, 956, 886

Species	Southern district—off California		Southern district—off Latin America				Total, southern district	
	San Diego division		San Pedro division		San Diego division			
FISH	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Albacore	24, 153	$3, 623					283, 141	$42, 297
Anchovies	730	14					56, 469	789
Barracuda	850, 491	52, 440	1, 713, 038	$221, 714	354, 204	$43, 153	6, 451, 472	505, 726
Bonito	680, 613	20, 069	711, 645	25, 348	58, 725	1, 985	2, 087, 627	67, 939
Eels							222	4
Flounders:								
"California halibut"	133, 938	18, 220	1, 178	198	254, 184	36, 428	1, 165, 984	159, 097
"Sole"	8, 683	1, 073					288, 734	13, 891
Other							17, 680	4, 933
Grayfish	13, 459	206					141, 838	3, 630
Herring	22, 527	232					23, 097	252
Horse mackerel			1, 906	116			511, 408	17, 103
Kingfish	4, 118	129					323, 479	6, 200
"Lingcod"							1, 046	64
Mackerel	2, 708, 049	43, 880			11, 196	687	33, 963, 318	577, 914
Mullet	23, 744	2, 312	6, 459	775	47, 041	4, 930	82, 739	8, 548
Perch	5, 768	303	312	24	978	47	84, 411	7, 176
Pilchard or sardine	7, 116, 560	49, 027					171, 735, 564	958, 122
Pompano	232	81	1, 286	134	25, 501	2, 731	27, 879	3, 356
Rock bass	157, 736	8, 975	7, 489	422	42, 837	3, 411	625, 871	44, 132
Rockfishes	1, 223, 036	70, 149			4, 938	374	3, 028, 121	170, 405
Sablefish							6, 673	541
Salmon							5	1
Sculpin	35, 988	3, 652					97, 083	9, 751
Sea bass:								
Black	138, 766	6, 617	11, 157	854	165, 686	7, 882	381, 705	19, 196
White or squeteague	171, 493	21, 489	130, 321	23, 528	345, 014	39, 494	1, 218, 929	156, 604
Sheepshead	34, 849	1, 294	188	11			372, 677	15, 781
Skates	2, 734	52					28, 519	589
Skipjack or striped tuna	2, 975, 313	111, 634	5, 216, 081	177, 579	6, 335, 891	224, 720	15, 813, 510	562, 156
Smelt	23, 637	1, 638	1, 167	62	54	3	568, 350	31, 839
Stingray	3, 296	16					3, 296	16
Swordfish	322, 196	37, 649					426, 001	50, 903
Tuna:								
Bluefin	2, 108, 381	133, 471					13, 700, 870	823, 401
Yellowfin	5, 264	329	15, 397, 232	758, 700	16, 771, 348	1, 009, 582	32, 251, 246	1, 773, 788
Whitefish	91, 788	4, 562	4, 530	288	22, 154	1, 154	222, 192	14, 371
Yellowtail	1, 004, 809	47, 451	521, 370	37, 638	865, 107	38, 598	2, 683, 514	138, 978
Other fish			5, 162	477	9, 496	550	139, 081	6, 261
Total	19, 892, 351	640, 587	23, 730, 521	1, 247, 868	25, 314, 354	1, 415, 729	288, 813, 751	6, 195, 754
SHELLFISH, ETC.								
Crabs							270	10
Sea crawfish or spiny lobster	131, 825	22, 971	350	32	720, 464	114, 518	1, 076, 614	190, 469
Abalone							10, 808	2, 958
Clams:								
Pismo							30, 763	9, 340
Soft							98	46
Octopus							50	14
Turtles					5, 594	450	5, 594	450
Total	131, 825	22, 971	350	32	726, 058	114, 968	1, 124. 197	203, 287
Grand total	20, 021, 176	663, 558	23, 730, 871	1, 247, 900	26, 040, 412	1, 530, 697	289, 937, 948	6, 399, 041

Fisheries of California, 1928—Continued

CATCH: BY WATERS

Species	Off California		Off Latin America	
	Pounds	*Value*	*Pounds*	*Value*
FISH				
Albacore	283,321	$12,324		
Anchovies	357,470	4,016		
Barracuda	4,385,214	240,971	2,067,242	$264,867
Bonito	1,317,963	40,644	770,370	27,333
Carp	157,283	2,501		
Catfish	458,392	63,569		
Cod, dry salted [1]	2,596,670	146,634		
Cod, tongues [1]	8,000	1,200		
Eels	227	5		
Flounders:				
"California halibut"	932,289	125,148	255,362	36,626
"Sole"	10,280,419	471,519		
Other	1,517,098	79,432		
Grayfish	623,816	13,275		
Hake	108,648	2,173		
Halibut	375,746	39,757		
Hardhead	61,699	6,922		
Herring	1,139,682	11,814		
Horse mackerel	538,446	18,082	1,906	116
Kingfish	441,758	12,087		
"Lingcod"	849,056	32,560		
Mackerel	35,251,298	616,630	11,196	687
Mullet	29,239	2,843	53,500	5,705
Perch	235,644	12,463	1,290	71
Pilchard or sardine	420,269,665	2,323,921		
Pompano	3,295	1,568	26,787	2,865
Rock bass	575,545	40,299	50,326	3,833
Rockfishes	6,415,049	309,526	4,938	374
Sablefish	916,955	37,848		
Salmon	4,478,566	480,711		
Sculpin	99,711	10,047		
Sea bass:				
Black	204,862	10,460	176,843	8,736
White or squeteague	805,403	102,079	475,335	63,022
Shad	2,088,878	69,281		
Sheepshead	372,489	15,770	188	11
Skates	458,926	9,230		
Skipjack or striped tuna	4,262,732	159,917	11,551,972	402,299
Smelt	915,498	58,469	1,221	65
Splittail	10,740	616		
Squawfish	3,780	221		
Striped bass	484,113	74,172		
Stingray	3,296	16		
Suckers	1,029	35		
Swordfish	426,001	50,903		
Tomcod	11,923	359		
Tuna:				
Bluefin	13,700,870	823,401		
Yellowfin	82,666	5,506	32,168,580	1,768,282
Whitebait	135,186	8,854		
Whitefish	195,508	12,929	26,684	1,442
Yellowtail	1,297,037	62,742	1,386,477	76,236
Other fish	181,735	6,830	14,658	1,027
Total	520,350,836	6,662,279	49,044,875	2,663,597
SHELLFISH, ETC.				
Crabs	3,574,734	290,452		
Sea crawfish or spiny lobster	355,800	75,919	720,814	114,550
Shrimp	2,280,871	38,269		
Abalone	420,783	84,953		
Clams:				
Cockle	3,020	2,250		
Pismo	31,302	9,502		
Soft	24,855	10,131		
Mixed	6,602	3,331		
Mussels	161	40		
Octopus	6,434	737		
Oysters:				
Eastern, market	72,630	30,699		
Native, market	4,028	1,726		
Squid	1,351,992	40,740		
Terrapin	168	20		
Turtles			5,594	450
Total	8,133,380	588,769	726,408	115,000
WHALE PRODUCT				
Whale oil	4,880,639	296,000		
Grand total	533,364,855	7,547,048	49,771,283	2,778,597

[1] The catch of cod was made in Alaska waters.

NORTHERN DISTRICT

The northern district is comprised of Del Norte, Humboldt, Mendocino, Sonoma, and Lake Counties. The catch in this district amounted to 4,580,841 pounds, valued at $381,794. Considered according to value the more important species comprising this catch were salmon, 2,774,315 pounds, valued at $277,837; halibut, 350,823 pounds, valued at $37,026; sablefish, 385,185 pounds, valued at $15,126; and catfish, 73,917 pounds, valued at $10,791.

Operating units.—The catch of fishery products in this district was taken by 548 fishermen, 15 motor vessels, 383 motor and other small boats, and 7 major types of gear. The combined capacity of the vessels amounted to 153 net tons.

Catch by gear.—Three types of gear accounted for 93 per cent of the fishery products taken in this district during 1928. In the order of their importance they were lines, which accounted for 72 per cent of the catch; gill nets, 14 per cent; and paranzella nets, 7 per cent. The catch by gill nets consisted principally of salmon; that by lines chiefly salmon, halibut, and sablefish; and that by paranzella nets mainly flounders.

Fisheries of the northern district of California, 1928

OPERATING UNITS: By gear

Items	Haul seines	Gill nets		Troll lines	Set and hand lines
		Drift, salmon	Other		
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels				28	29
On boats and shore	9	301	25	155	94
Total	9	301	25	183	123
Vessels, motor				14	8
Net tonnage				132	91
Boats:					
Motor	2		13	141	69
Other	2	194	9		
Apparatus:					
Number	2	198	22	706	199
Length, yards	400				
Square yards		129,200	10,860		
Hooks				3,298	23,750

Items	Dip nets	Paranzella nets	Crab traps	Shovels	Total, exclusive of duplication
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels		7			46
On boats and shore	29		29	6	502
Total	29	7	29	6	548
Vessels, motor		2			15
Net tonnage		14			153
Boats:					
Motor			19		144
Other	29		7	6	239
Apparatus:					
Number	29	1	476	6	
Yards at mouth		17			

Fisheries of the northern district of California, 1928—Continued

CATCH: BY GEAR

Fish	Haul seines		Gill nets		Troll lines	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp	74,894	$262				
Flounders, other than "sole"			12,220	$603		
Halibut					10,988	$956
Hardhead	11,090	39				
Herring			61,442	1,009		
"Lingcod"					23,369	480
Perch			36,174	1,264		
Pilchard or sardine			87	4		
Rockfishes					2,713	59
Salmon	12,394	876	467,411	46,698	2,294,510	230,263
Smelt			63,161	3,876		
Total	98,378	1,177	640,495	53,454	2,331,580	231,758

Fish	Set and hand lines		Dip nets		Paranzella nets	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Catfish	73,917	$10,791				
Flounders:						
"Sole"	4,011	86			218,030	$8,721
Other					80,970	4,049
Grayfish					260	5
Halibut	339,799	36,066			36	4
"Lingcod"	66,503	2,108			18,460	614
Perch			5,291	$208		
Rockfishes	84,411	2,098			20,140	504
Sablefish	385,185	15,126				
Skates					2,340	47
Whitebait			116,716	7,256		
Other fish	4,806	96			1,950	39
Total	958,652	66,371	122,007	7,464	342,186	13,983

Shellfish	Traps		Shovels	
	Pounds	*Value*	*Pounds*	*Value*
Crabs	86,068	$7,174		
Clams:				
Cockle			34	$11
Soft			95	24
Mixed			1,346	378
Total	86,068	7,174	1,475	413

SAN FRANCISCO DISTRICT

The San Francisco district is comprised of Marin, Solano, Yolo, Sacramento, San Joaquin, Alameda, Contra Costa, San Francisco, and San Mateo Counties. The catch in this district amounted to 57,628,317 pounds, valued at $1,842,761. Considered according to value the more important species comprising this catch were flounders, 9,109,738 pounds, valued at $415,596; crabs, 3,014,760 pounds, valued at $251,230; salmon, 1,369,592 pounds, valued at $161,900; dry-salted cod, 2,596,670 pounds, valued at $146,634; and pilchard or sardine, 26,965,736 pounds, valued at $144,837.

Operating units.—The catch of fishery products in the San Francisco district during 1928 was taken by 1,310 fishermen, 4 steam vessels, 26 motor vessels, 4 sailing vessels, 695 motor and other small boats, and 12 major types of gear. The combined capacity of the vessels amounted to 2,246 net tons.

Catch by gear.—Five types of gear accounted for 89 per cent of the fishery products taken in this district during 1928. Listed in order of their importance they were lampara nets, which accounted for 48 per cent of the catch; paranzella nets, 19 per cent; harpoons, 8 per cent; and lines and gill nets, each, 7 per cent. The catch by lampara nets was chiefly pilchard or sardine, that by paranzella nets principally flounders, that by harpoons exclusively whales, that by gill nets chiefly striped bass, salmon and shad; and that by lines largely cod taken in Alaska waters.

Fisheries of the San Francisco district of California, 1928

OPERATING UNITS: BY GEAR

Items	Haul seines	Gill nets					Troll lines	Set and hand lines	Fyke nets
		Drift, salmon	Sea bass	Shad	Striped bass	Other			
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:									
On vessels							4	144	
On boats and shore	35	426	30	378	269	36	252	45	95
Total	35	426	30	378	269	36	256	189	95
Vessels:									
Motor							2	2	
Net tonnage							16	40	
Sail								4	
Net tonnage								1, 598	
Total vessels							2	6	
Total net tonnage							16	1, 638	
Boats:									
Motor	8	228	17	234	166		236	21	37
Other		5		7	7				43
Apparatus:									
Number	8	233	17	241	173	29	982	446	1, 248
Length, yards	960								
Square yards		573, 646	25, 646	576, 954	364, 338	24, 640			
Hooks							4, 902	36, 168	

Items	Bag nets	Lampara nets, sardine	Paranzella nets	Beam trawls	Crab traps	Harpoons, whale	Tongs	Shovels and rakes	Total, exclusive of duplication
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:									
On vessels	15		85			44			285
On boats and shore	20	75		28	204		6	18	1, 025
Total	35	75	85	28	204	44	6	18	1, 310
Vessels:									
Steam						4			4
Net tonnage						241			241
Motor	3		22						26
Net tonnage	18		359						407
Sail									4
Net tonnage									1, 598
Total vessels	3		22			4			34
Total net tonnage	18		359			241			2, 246
Boats:									
Motor	5	16		24	204		2	5	643
Other							6	4	52
Apparatus:									
Number	8	16	11	24	4, 080	4	6	18	
Length, yards	4, 272	3, 776							
Yards at mouth			183	148					

Fisheries of the San Francisco district of California, 1928—Continued

CATCH: BY GEAR

Species	Haul seines		Gill nets		Troll lines		Set and hand lines	
FISH	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Anchovies	2,229	$22	6,650	$67				
Carp			27,853	477				
Catfish			9,612	1,384				
Cod, dry-salted							2,596,670	$146,634
Cod tongues							8,000	1,200
Eels							5	1
Flounders:								
"Sole"							6,395	320
Other	1,110	49	1,820	55			21	1
Grayfish							9,981	199
Halibut					662	$53	917	110
Herring	89,507	895	430,615	4,306				
Kingfish	133	5	33	1				
"Lingcod"					2,817	56	195,872	6,856
Perch	38,504	1,155	42,232	1,367				
Pilchard or sardine	21,200	212	8,838	88				
Rockfishes					3,245	65	557,094	27,855
Sablefish							236,866	10,659
Salmon			556,708	72,483	812,884	89,417		
Sea bass, white or squeteague	244	30	34,998	5,244				
Shad			2,088,878	69,281				
Smelt	11,081	887	98,979	8,346				
Squawfish			1,254	52				
Striped bass			484,113	74,172				
Suckers			72	2				
Tomcod	9,734	292						
Whitebait	5,916	503	1,271	108				
Other fish			1,234	25			91	2
Total	179,658	4,050	3,795,160	237,458	819,608	89,591	3,611,912	193,837
SHELLFISH, ETC.								
Shrimp	2,309	46						
Octopus			2,499	250				
Total	2,309	46	2,499	250				
Grand total	181,967	4,096	3,797,659	237,708	819,608	89,591	3,611,912	193,837

Species	Fyke nets		Bag nets		Lampara nets		Paranzella nets	
FISH	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Anchovies					116,636	$1,166		
Carp	54,536	$1,762						
Catfish	374,863	51,394						
Flounders:								
"Sole"							7,952,305	$357,854
Other					1,907	74	1,146,180	57,243
Grayfish							390,497	7,810
Hake							76,047	1,521
Halibut							23,344	2,568
Hardhead	50,609	6,883						
Herring					534,456	5,345		
Kingfish					1,753	71	24,866	995
"Lingcod"							326,028	11,411
Mackerel					2,127	64	135	4
Perch					5,370	161	890	40
Pilchard or sardine					26,934,893	144,529	805	8
Rockfishes							437,919	19,707
Sablefish							105,163	4,732
Sea bass, white or squeteague					673	114		
Skates							315,517	6,310
Smelt					3,496	279	150	12
Splittail	10,740	616						
Squawfish	2,526	169						
Suckers	957	33						
Tomcod					85	3	1,979	59
Whitebait					7,434	630		
Other fish	50	3					28,639	859
Total	494,281	60,860			27,608,830	152,436	10,830,464	471,133
SHELLFISH, ETC.								
Crabs							9,022	752
Shrimp			348,724	$5,850				
Octopus							54	5
Total			348,724	5,850			9,076	757
Grand total	494,281	60,860	348,724	5,850	27,608,830	152,436	10,839,540	471,890

Fisheries of the San Francisco district of California, 1928—Continued

CATCH: BY GEAR—Continued

Species	Beam trawls		Traps		Harpoons	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
SHELLFISH, ETC.						
Crabs			3,005,738	$250,478		
Shrimp	1,929,838	$32,373				
Total	1,929,838	32,373	3,005,738	250,478		
WHALE PRODUCT						
Whale oil					4,880,639	$296,000
Grand total	1,929,838	32,373	3,005,738	250,478	4,880,639	296,000

Species	Tongs		Rakes		Shovels		By hand	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
SHELLFISH, ETC.								
Clams:								
Cockle					2,986	$2,239		
Soft					24,642	10,054		
Mixed					5,103	2,892		
Mussels			24	$12				
Oysters:								
Eastern, market	72,630	$30,699						
Native, market	4,028	1,726						
Terrapin							168	$20
Total	76,658	32,425	24	12	32,731	15,185	168	20

MONTEREY DISTRICT

The Monterey district is comprised of Monterey and Santa Cruz Counties. The catch in this district amounted to 230,989,032 pounds, valued at $1,702,049. The most important product contributing to this catch was pilchard or sardine, the catch of which amounted to 221,568,278 pounds, valued at $1,220,958. Other important species were flounders, 2,087,801 pounds, valued at $105,749; rockfishes, 2,286,344 pounds, valued at $89,207; and abalone, 409,975 pounds, valued at $81,995.

Operating units.—The catch of fishery products in the Monterey district during 1928 was taken by 1,120 fishermen, 10 motor vessels, 289 motor and other small boats, and 9 major types of gear. The combined capacity of the vessels amounted to 110 net tons.

Catch by gear.—Three types of gear accounted for 98 per cent of the fishery products taken in this district during 1928. Listed in order of their importance they were lampara nets, which accounted for 92 per cent of the catch; purse seines, 5 per cent; and lines, 1 per cent. The catch by lampara nets was principally pilchard or sardine, that by purse seines, exclusively pilchard or sardine, and that by lines chiefly rockfishes, mackerel, and salmon.

Fisheries of the Monterey district of California, 1928

OPERATING UNITS: BY GEAR

Items	Purse seines, sardine	Gill nets			Troll lines	Set and hand lines	Lampara nets	
		Crab	Sea bass	Other			Sardine	Squid
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	26				4	4	54	6
On boats and shore		45	34	82	223	161	669	237
Total	26	45	34	82	227	165	723	243
Vessels, motor	3				2	2	5	1
Net tonnage	60				11	12	38	11
Boats:								
Motor		24	20	64	201	136	55	40
Other				6		10		
Apparatus:								
Number	3	24	20	70	535	990	60	40
Length, yards	930						20, 354	10, 120
Square yards		57, 810	30, 861	47, 320				
Hooks					2, 666	181, 720		

Items	Paranzella nets	Traps		Rakes	Shovels	Abalone outfits	Total, exclusive of duplication
		Crab	Octopus				
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels						5	90
On boats and shore	2	3	5	2	5	50	1, 030
Total	2	3	5	2	5	55	1, 120
Vessels, motor						1	10
Net tonnage						6	110
Boats:							
Motor	1	3	5			10	276
Other							13
Apparatus:							
Number	1	35	22	2	5	11	
Yards at mouth	17						

CATCH: BY GEAR

Species	Purse seines		Gill nets		Troll lines		Set and hand lines	
FISH	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Albacore					180	$27		
Anchovies			636	$14				
Barracuda			86	9	90	10		
Bonito			596	31				
Flounders:								
"California halibut"			440	52	76	10	5, 984	$790
"Sole"			1, 435	72	64	3	20, 211	1, 110
Other					173	10	5, 679	275
Grayfish							200	1
Hake							80	2
Herring			125	2				
Horse mackerel			1, 579	129	361	20	1, 420	82
Kingfish			48, 622	2, 698			1, 805	103
"Lingcod"					4, 233	218	140, 283	7, 603
Mackerel			218	7	257, 873	7, 888	756, 288	23, 159
Perch			12, 586	625				
Pilchard or sardine	11, 835, 755	$65, 097	2, 261	45				
Rockfishes					11, 846	431	2, 178, 869	84, 976
Sablefish							175, 584	6, 528
Salmon					334, 654	40, 973		
Sculpin							2, 628	296
Sea bass; white or squeteague			22, 553	2, 697			105	8
Skates							5, 222	138
Skipjack or striped tuna			1, 194	60				

Fisheries of the Monterey district of California, 1928

CATCH: BY GEAR—Continued

Species	Purse seines		Gill nets		Troll lines		Set and hand lines	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
FISH—continued								
Smelt			144,537	$11,214			259	$21
Whitebait			1,147	111				
Other fish			3,215	80	780	$23	8,080	181
Total	11,835,755	$65,097	241,230	17,846	610,330	49,613	3,302,697	125,273
SHELLFISH, ETC.								
Crabs			470,424	31,802				
Octopus							821	96
Squid			197	10				
Total			470,621	31,812			821	96
Grand total	11,835,755	65,097	711,851	49,658	610,330	49,613	3,303,518	125,369

Species	Lampara nets		Paranzella nets		Traps		Shovels and rakes		Abalone outfits	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
FISH										
Anchovies	174,850	$1,958								
Barracuda	808	93								
Bonito	110	7								
Flounders:										
"California halibut"	522	68	14,645	$1,757						
"Sole"	339	17	1,788,895	89,445						
Other	103	4	249,235	12,136						
Grayfish			81,040	1,630						
Hake			32,521	650						
Herring	440	5								
Horse mackerel	25,584	864								
Kingfish	21,641	1,043	19,426	971						
"Lingcod"	475	22	69,970	3,128						
Mackerel	282,535	8,281								
Perch	9,451	444	2,025	94						
Pilchard or sardine	209,730,262	1,155,816								
Pompano	2,203	1,077								
Rockfishes	2,973	94	92,656	3,706						
Sablefish			7,484	262						
Sea bass, white or squeteague	3,236	404								
Skates			107,328	2,146						
Smelt	26,706	2,060								
Tomcod			125	5						
Whitebait	2,702	246								
Other fish	1,530	80	6,937	208						
Total	210,286,470	1,172,583	2,472,287	116,138						
SHELLFISH, ETC.										
Abalone									409,975	$81,995
Clams:										
Pismo							539	$162		
Soft							20	7		
Mixed							153	61		
Crabs					3,192	$236				
Mussels							137	28		
Octopus			322	34	2,688	338				
Squid	1,351,795	40,730								
Total	1,351,795	40,730	322	34	5,880	574	849	258	409,975	81,995
Grand total	211,638,265	1,213,313	2,472,609	116,172	5,880	574	849	258	409,975	81,995

SOUTHERN DISTRICT

The combined catch of the San Pedro and San Diego divisions, which comprise the southern district, amounted to 289,937,948 pounds, valued at $6,399,041. This includes the catch off the coast of California and that off the coast of Latin America. Considered according to value the more important species contributing to this catch were yellowfin tuna, 32,251,246 pounds, valued at $1,773,788; pilchard or sardine, 171,735,564 pounds, valued at $958,122; bluefin tuna, 13,700,870 pounds, valued at $823,401; and mackerel, 33,963,318 pounds, valued at $577,914.

The operating units and catch of the principal species are discussed for each division individually in the following paragraphs.

SAN PEDRO DIVISION

The San Pedro division is comprised of San Luis Obispo, Santa Barbara, Ventura, Los Angeles, and Orange Counties.

Operating units.—The catch of fishery products in the San Pedro division was taken by 2,902 fishermen, 257 motor vessels, 551 motor and other small boats, and 10 major types of gear. The combined capacity of the vessels amounted to 4,889 net tons.

OFF CALIFORNIA

That part of the catch in this division taken off the California coast amounted to 220,142,489 pounds, valued at $2,956,886. Considered according to value the more important species were pilchard or sardine, 164,619,004 pounds, valued at $909,095; bluefin tuna, 11,592,489 pounds, valued at $689,930; and mackerel, 31,244,073 pounds, valued at $533,347.

Catch by gear.—Three types of gear accounted for 99 per cent of the fishery products taken off the California coast and landed in San Pedro division during 1928. In order of their importance they were lampara nets, which accounted for 50 per cent of the catch; purse seines, 44 per cent; and lines, 5 per cent. The catch by lampara nets was principally pilchard or sardine and mackerel; that by purse seines principally pilchard or sardine, bluefin tuna, and mackerel; and that by lines chiefly rockfishes, mackerel, skipjack or striped tuna, and albacore.

OFF LATIN AMERICA

That part of the catch of the San Pedro division taken off the coast of Latin America amounted to 23,730,871 pounds, valued at $1,247,900. Considered according to value the more important species were yellowfin tuna, 15,397,232 pounds, valued at $758,700; barracuda, 1,713,038 pounds, valued at $221,714; and skipjack or striped tuna, 5,216,081 pounds, valued at $171,579.

Catch by gear.—Two types of gear accounted for more than 99½ per cent of the fishery products taken off the coast of Latin America, and landed in the San Pedro division during 1928. Of these, troll lines accounted for 53 per cent and purse seines 47 per cent. The catch by troll lines was principally yellowfish tuna and skipjack or striped tuna and that by purse seines principally yellowfin tuna and barracuda.

Fisheries of the San Pedro division of the southern district of California, 1928

OPERATING UNITS: BY GEAR

Items	Purse seines			Gill nets			Trammel nets	Troll lines
	Barracuda	Sardine	Tuna	Barracuda	Sea bass	Other		
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:								
On vessels	437	673	595	52	36	14	48	676
On boats and shore				127	84	33	81	435
Total	437	673	595	179	120	47	129	1,111
Vessels, motor	48	71	62	15	10	3	17	127
Net tonnage	1,278	2,080	1,751	98	70	17	121	2,000
Boats:								
Motor				49	34	14	33	290
Other				2	4	5	1	4
Apparatus:								
Number	48	71	62	66	48	26	51	2,693
Length, yards	20,320	27,570	34,133					
Square yards				430,244	259,766	18,798	365,766	
Hooks								2,693

Items	Set and hand lines	Lampara nets, sardine	Paranzella nets	Lobster traps	Harpoons, swordfish	Shovels	Abalone outfits	Total, exclusive of duplication
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:								
On vessels	122	706	8	28	8			1,877
On boats and shore	451	81	25	167	27	158	7	1,025
Total	573	787	33	195	35	158	7	2,902
Vessels, motor	45	86	2	10	3			257
Net tonnage	368	1,010	22	75	20			4,889
Boats:								
Motor	281	16	8	79	15		5	499
Other	38			10				52
Apparatus:								
Number	1,351	102	5	2,644	24	158	7	
Length, yards		39,830						
Yards at mouth			84					
Hooks	292,978							

CATCH OFF CALIFORNIA: BY GEAR

Species	Purse seines		Gill nets		Trammel nets		Troll lines	
FISH	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Albacore	803	$122					258,185	$38,552
Barracuda	1,314,568	66,470	884,910	$61,324			497,381	22,631
Bonito	482,087	16,547	59,997	1,522	130	$4	35,507	799
Flounders:								
"California halibut"	106	15	27	3	496,692	72,967		
"Sole"	147	7			54,637	2,955		
Other			23	1	718	39		
Grayfish	702	18	33,206	954	39,166	1,170	209	6
Herring			570	20				
Horse mackerel	147,869	3,900	29,494	1,328				
Kingfish	1,138	23						
"Lingcod"					14	1		
Mackerel	3,010,800	41,887	199,301	3,632	283	8	839,990	11,980
Mullet			5,495	531				
Perch	1,887	175	5,826	454	1,297	82		
Pilchard or sardine	80,750,501	444,128						
Pompano			8	4				
Rock bass	12,441	829	277	14	473	24	85,408	5,266
Rockfishes	2,101	93	130	7	3,021	169		
Salmon							5	1
Sculpin					240	14		

Fisheries of the San Pedro division of the southern district of California, 1928—Con.

CATCH OFF CALIFORNIA: BY GEAR—Continued

Species	Purse seines		Gill nets		Trammel nets		Troll lines	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
FISH—continued								
Sea bass:								
Black	1,372	$75	4,804	$302	2,073	$138	-------	------
White or squeteague	31,743	4,948	360,601	41,830	1,718	301	-------	------
Sheepshead	873	40	-------	------	1,990	94	-------	------
Skates	-------	------	-------	------	23,038	479	-------	------
Skipjack or striped tuna	-------	------	-------	------	-------	------	1,286,225	$48,223
Smelt	2,340	106	106,313	6,161	-------	------	-------	------
Swordfish	-------	------	-------	------	-------	------	2,398	105
Tuna:								
Bluefin	11,004,691	642,916	-------	------	204	15	287,403	27,027
Yellowfin	113	7	-------	------	-------	------	75,084	4,916
Whitefish	685	40	-------	------	380	21	-------	------
Yellowtail	102,883	7,046	7,367	494	124	13	147,514	5,142
Other fish	926	33	48,046	1,408	5,142	155	148	12
Total	96,870,776	1,229,425	1,746,395	119,989	631,340	78,649	3,515,457	167,660
SHELLFISH, ETC.								
Sea crawfish or spiny lobster	-------	------	-------	------	7,800	1,778	-------	------
Grand total	96,870,776	1,229,425	1,746,395	119,989	639,140	80,427	3,515,457	167,660

Species	Set and hand lines		Lampara nets		Paranzella nets		Traps	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
FISH								
Anchovies	-------	------	55,739	$775	-------	------	-------	------
Barracuda	-------	------	836,880	37,994	-------	------	-------	------
Bonito	5,195	$182	53,728	1,483	-------	------	-------	------
Eels	222	4	-------	------	-------	------	-------	------
Flounders:								
"California halibut"	34,269	4,740	713	107	244,877	$26,419	-------	------
"Sole"	6,981	468	95	6	218,191	9,382	-------	------
Other	16,939	4,893	-------	------	-------	------	-------	------
Grayfish	48,745	1,147	6,319	128	-------	------	32	$1
Horse mackerel	2,437	80	329,702	11,679	-------	------	-------	------
Kingfish	17,710	354	298,480	5,650	-------	------	2,033	44
"Lingcod"	1,032	63	-------	------	-------	------	-------	------
Mackerel	4,509,827	97,593	22,683,872	375,247	-------	------	-------	------
Perch	4,072	250	59,624	5,434	483	29	4,164	378
Pilchard or sardine	-------	------	83,868,503	464,967	-------	------	-------	------
Pompano	-------	------	852	406	-------	------	-------	------
Rock bass	92,211	7,893	69,887	4,205	-------	------	157,112	13,093
Rockfishes	1,792,336	99,432	1,815	143	-------	------	744	38
Sablefish	6,673	541	-------	------	-------	------	-------	------
Sculpin	60,855	6,085	-------	------	-------	------	-------	------
Sea bass:								
Black	51,570	2,946	6,057	373	220	9	-------	------
White or squeteague	23,392	2,450	154,647	22,564	-------	------	-------	------
Sheepshead	72,674	3,223	4,290	206	-------	------	257,813	10,913
Skates	2,747	58	-------	------	-------	------	-------	------
Smelt	5,399	311	429,440	23,558	-------	------	-------	------
Tuna:								
Bluefin	-------	------	300,191	19,972	-------	------	-------	------
Yellowfin	-------	------	2,205	254	-------	------	-------	------
Whitefish	100,835	8,188	456	29	-------	------	1,364	89
Yellowtail	3,132	141	31,208	2,455	-------	------	-------	------
Other fish	63,705	3,198	5,297	365	-------	------	1,159	63
Total	6,922,958	244,240	109,200,000	978,000	463,771	35,839	424,421	24,619
SHELLFISH, ETC.								
Crabs	-------	------	-------	------	-------	------	270	10
Octopus	50	14	-------	------	-------	------	-------	------
Sea crawfish or spiny lobster	-------	------	-------	------	860	140	215,315	51,030
Total	50	14	-------	------	860	140	215,585	51,040
Grand total	6,923,008	244,254	109,200,000	978,000	464,631	35,979	640,006	75,659

Fisheries of the San Pedro division of the southern district of California, 1928—Con.

CATCH OFF CALIFORNIA: BY GEAR—Continued

Species	Harpoons		Shovels		Abalone outfits	
FISH	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Swordfish	101,407	$13,149				
Total	101,407	13,149				
SHELLFISH, ETC.						
Abalone					10,808	$2,958
Clams:						
Pismo			30,763	$9,340		
Soft			98	46		
Total			30,861	9,386	10,808	2,958
Grand total	101,407	13,149	30,861	9,386	10,808	2,958

CATCH OFF LATIN AMERICA: BY GEAR

Species	Purse seines		Gill nets		Trammel nets	
FISH	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Barracuda	1,712,407	$221,640	262	$34		
Bonito	683,331	24,406				
Flounders, "California halibut"	798	142			380	$56
Horse mackerel	1,906	116				
Perch	312	24				
Rock bass	851	83				
Sea bass:						
Black	8,226	663				
White or squeteague	119,529	21,904	8,813	1,324		
Sheepshead	188	11				
Skipjack or striped tuna	172,202	4,018				
Smelt	1,167	62				
Tuna, yellowfin	7,908,213	330,280				
Whitefish	1,745	115				
Yellowtail	481,421	35,301				
Other fish	947	67				
Total	11,093,243	638,832	9,075	1,358	380	56

Species	Troll lines		Set and hand lines		Lampara nets		Traps	
FISH	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Barracuda	369	$40						
Bonito	28,314	942						
Mullet					6,459	$775		
Pompano					1,286	134		
Rock bass			6,638	$339				
Sea bass:								
Black	134	9	1,817	104	980	78		
White or squeteague			40	7	1,939	293		
Skipjack or striped tuna	5,043,879	173,561						
Tuna, yellowfin	7,489,019	428,420						
Whitefish			2,785	173				
Yellowtail	39,699	2,312			250	25		
Other fish					4,215	410		
Total	12,601,414	605,284	11,280	623	15,129	1,715		
SHELLFISH, ETC.								
Sea crawfish or spiny lobster							350	$32
Grand total	12,601,414	605,284	11,280	623	15,129	1,715	350	32

SAN DIEGO DIVISION

The San Diego division is comprised of San Diego and Imperial Counties.

Operating units.—The catch of fishery products in the San Diego division was taken by 964 fishermen, 119 motor vessels, 169 motor and other small boats, and 6 major types of gear. The combined capacity of the vessels amounted to 2,883 net tons.

OFF CALIFORNIA

That part of the catch taken off the California coast of the San Diego division amounted to 20,024,176 pounds, valued at $663,558. Considered according to value the more important species were bluefin tuna, 2,108,381 pounds, valued at $133,471; skipjack or striped tuna, 2,975,313 pounds, valued at $111,634; and rockfishes, 1,233,036 pounds, valued at $70,149.

Catch by gear.—Three types of gear accounted for 94 per cent of the fishery products taken off the coast of California and landed in the San Diego division during 1928. In the order of their importance they were lampara nets, which accounted for 44 per cent of the catch; lines, 40 per cent; and purse seines, 10 per cent. The catch by lampara nets was made up principally of pilchard or sardine, mackerel, and bonito; that by lines was chiefly skipjack or striped tuna, mackerel, rockfishes, and yellowtail; and that by purse seines was almost exclusively bluefin tuna.

OFF LATIN AMERICA

That part of the catch of the San Diego division taken off the Latin American coast amounted to 26,040,412 pounds, valued at $1,530,697. Considered according to value the more important species were yellowfin tuna, 16,771,348 pounds, valued at $1,009,582; skipjack or striped tuna, 6,335,891 pounds, valued at $224,720; and sea crawfish or spiny lobsters, 720,464 pounds, valued at $114,518.

Catch by gear.—Two types of gear accounted for 95 per cent of the catch of fishery products taken off the coast of Latin America and landed in the San Diego division. Lines accounted for 90 per cent of the catch and purse seines, 5 per cent. The catch by lines consisted principally of yellowfin tuna and skipjack or striped tuna and that by purse seines principally yellowfin tuna.

Fisheries of the San Diego division of the southern district of California, 1928

OPERATING UNITS: BY GEAR

Items	Gill nets			Trammel nets	Troll lines	Set and hand lines
	Barracuda	Sea bass	Other			
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	24	15		19	600	163
On boats and shore	49	43	16	40	171	153
Total	73	58	16	59	771	316
Vessels, motor	7	4		5	105	39
Net tonnage	56	32		44	2,719	431
Boats:						
Motor	19	18	12	15	110	90
Other			4		1	4
Apparatus:						
Number	26	22	14	20	1,598	719
Square yards	145,647	102,870	10,500	248,770		
Hooks					1,598	142,969

Fisheries of the San Diego division of the southern district of California, 1928—Continued

OPERATING UNITS: BY GEAR—Continued

Items	Lampara nets, sardine	Lobster traps	Harpoons		Total, exclusive of duplication
			Swordfish	Turtles	
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	200	32	41	6	669
On boats and shore	47	81	39	2	295
Total	247	113	80	8	964
Vessels, motor	35	10	11	1	119
Net tonnage	331	79	122	15	2,883
Boats:					
Motor	9	50	21	1	157
Other		4			12
Apparatus:					
Number	44	2,190	47	4	
Length, yards	12,858				

CATCH OFF CALIFORNIA: BY GEAR

Species	Purse seines		Gill nets		Trammel nets		Troll lines	
FISH	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Albacore	58	$9					24,095	$3,614
Barracuda	20,017	1,251	202,609	$13,266			627,865	37,923
Bonito	18,707	517	45,895	1,313			252,047	7,337
Flounders:								
"California halibut"					129,516	$18,109		
Herring			22,527	232				
Mackerel	200	8	82,433	1,557			33,085	553
Mullet			23,744	2,312				
Perch			2,611	143				
Rock bass	1,077	70	675	28			5,772	239
Rockfishes					586	35		
Sea bass:								
Black			1,012	49	2,758	133		
White, or squeteague	60	10	111,876	13,548	46	8	4,098	483
Sheepshead			60	3				
Skates					1,576	29		
Skipjack or striped tuna							2,975,313	111,634
Smelt			16,378	1,189				
Tuna:								
Bluefin	2,055,801	130,167					29,039	1,774
Yellowfin							5,264	329
Yellowtail	746	60	10,144	309			991,713	46,866
Total	2,096,666	132,092	519,964	33,949	134,482	18,314	4,948,291	210,752

Species	Set and hand lines		Lampara nets		Traps		Harpoons	
FISH	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Anchovies			730	$14				
Bonito	8,353	$259	355,611	10,643				
Flounders:								
"California halibut"	4,422	111						
"Sole"	8,683	1,073						
Grayfish	13,459	206						
Kingfish	3,421	108	697	21				
Mackerel	1,315,954	23,570	1,276,377	18,192				
Perch	385	20	2,531	126	241	$14		
Pilchard or sardine			7,116,560	49,027				
Pompano	194	68	38	13				
Rock bass	71,395	3,694	53,470	2,817	25,347	2,127		
Rockfishes	1,222,450	70,114						
Sculpin	35,988	3,652						
Sea bass:								
Black	134,996	6,435						
White, or squeteague	28,146	4,136	27,267	3,304				

Fisheries of the San Diego division of the southern district of California, 1928 – Continued

CATCH OFF CALIFORNIA: BY GEAR—Continued

Species	Set and hand lines		Lampara nets		Traps		Harpoons	
FISH—continued	*Pounds*	*Value*	*Pounds*	*Vales*	*Pounds*	*Value*	*Pounds*	*Value*
Sheepshead	16,163	$633	901	$38	17,725	$620		
Skates	1,158	23						
Smelt	554	23	6,705	426				
Stingray	3,296	16						
Swordfish							322,196	$37,649
Tuna, bluefin			23,541	1,530				
Whitefish	91,788	4,562						
Yellowtail	1,571	193	635	23				
Total	2,962,376	118,896	8,865,063	86,174	43,313	2,761	322,196	37,649
SHELLFISH, ETC.								
Sea crawfish or spiny lobster					131,825	22,971		
Grand total	2,962,376	118,896	8,865,063	86,174	175,138	25,732	322,196	37,649

NOTE.—The catch by purse seines was made by fishermen from the San Pedro division.

CATCH OFF LATIN AMERICA: BY GEAR

Species	Purse seines		Gill nets		Trammel nets		Troll lines	
FISH	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Barracuda	64,884	$7,432	47,869	$6,561			241,451	$29,160
Bonito			2,325	99			52,403	1,794
Flounders, "California halibut"					254,184	$36,428		
Mackerel			42	1				
Mullet	47,041	4,930						
Rock bass	115	11	217	9			4,851	406
Sea bass:								
Black	650	27	12,980	691	15,806	808		
White or squeteague	740	63	286,096	33,711			958	71
Skipjack or striped tuna	55,953	1,444					6,279,938	223,276
Tuna, yellowfin	1,072,457	41,075					15,698,891	968,507
Whitefish	765	31						
Yellowtail	9,553	734	4,692	166			780,571	32,905
Other fish			150	5				
Total	1,252,158	55,747	354,371	41,243	269,990	37,236	23,059,063	1,256,119

Species	Set and hand lines		Lampara nets		Traps		Harpoons	
FISH	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bonito			3,997	$92				
Mackerel	10,343	$621	811	65				
Perch			978	47				
Pompano			25,501	2,731				
Rock bass	29,144	2,385	8,510	600				
Rockfishes	4,938	374						
Sea bass:								
Black	125,239	5,806	11,011	550				
White or squeteague	46,065	4,048	11,155	1,601				
Smelt			54	3				
Whitefish	21,389	1,123						
Yellowtail			70,291	4,793				
Other fish			9,346	545				
Total	237,118	14,357	141,654	11,027				
SHELLFISH, ETC.								
Sea crawfish, or spiny lobster					720,464	$114,518		
Turtles							5,594	$450
Grand total	237,118	14,357	141,654	11,027	720,464	114,518	5,594	450

INDUSTRIES RELATED TO THE FISHERIES

Transporting trade.—There were 83 persons in 1928 who were engaged in California in transporting the catch of fish. In this trade 1 steam vessel, 18 motor vessels, and 4 sailing vessels, having a combined capacity of 3,256 net tons, were operated.

Wholesale trade.—There were 59 wholesale establishments along the coast of California engaged primarily in the handling of fresh and frozen products. This is 54 per cent of the total number of such establishments in the Pacific coast section. These establishments employed 620 persons who received $1,153,053 in salaries and wages.

Prepared and by-products trade.—There were 67 establishments in California during 1928 engaged primarily in the manufacture of prepared fishery products or by-products. This is 40 per cent of the total number in the Pacific coast section. They employed 6,740 persons who received $3,947,370 in salaries and wages. The products manufactured, consisting principally of canned sardines and tuna and tunalike fishes, were valued at $24,531,740. Detailed statistics of most of the items manufactured may be obtained from Fishery Industries of the United States, 1928, Bureau of Fisheries Document No. 1067.

Industries related to the fisheries of California, 1928

TRANSPORTING

Items	Number
Men on transporting vessels	83
Transporting vessels:	
Steam	1
Net tonnage	331
Motor	18
Net tonnage	1,405
Sail	4
Net tonnage	1,520
Total	23
Net tonnage	3,256

WHOLESALE FISHERY TRADE:

Items	San Francisco and northern district	Monterey district	Southern district: San Pedro division	Southern district: San Diego division	Total
Establishments	16	13	22	8	59
Persons engaged:					
Proprietors and salaried employees	52	26	58	15	151
Wage earners	267	58	102	42	469
Paid to salaried employees	$155,700	$46,800	$148,280	$31,518	$382,298
Paid to wage earners	427,938	74,700	187,240	80,877	770,755
Total salaries and wages	583,638	121,500	335,520	112,395	1,153,053

Industries related to the fisheries of California, 1928—Continued

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS

Items	Number	Products	Quantity	Value
Establishments	67	Salted:		
Persons engaged:		Salmon, mild cured..pounds	1,552,800	$465,830
Proprietors and salaried employees	618	Other..do	784,548	62,025
Wage earners	6,122	Smoked..do	232,822	60,565
		Dried..do	354,977	37,733
		Canned:		
Paid to salaried employees	$1,180,453	Sardines....standard cases[1]	2,771,534	9,658,822
Paid to wage earners	2,766,917	Tuna and tunalike fishes standard cases	1,216,222	8,374,030
Total salaries and wages	3,947,370	Mackerel..do	388,521	1,621,595
		Miscellaneous[2]		224,498
		By-products:		
		Fish meal, scrap, and flour tons	27,505	1,650,012
		Fish and whale oils..gallons	4,526,700	1,939,259
		Miscellaneous[3]		437,371
		Total		24,531,740

[1] A standard case contains forty-eight 1-pound cans of sardines and mackerel, or forty-eight ½-pound cans of tuna and tunalike fishes.
[2] Includes canned squid, abalone, shad, shad roe, salmon, barracuda, barracuda fish cakes, and fish for cat and dog food.
[3] Includes liquid glue, pilchard scales, agar, and kelp products.

HISTORICAL REVIEW

Fourteen general surveys have been made for statistics of the fisheries of the Pacific Coast States during the 41 years from 1888 to 1928. The catch for 1888 amounted to 91,244,000 pounds. Since that time the catch has continued to increase, with the largest catch on record shown for 1928, when 693,484,000 pounds were taken. Comparative statistics for each of the more important species taken are shown in the following tables.

Fisheries of the Pacific Coast States, 1888 to 1928

[Expressed in thousands of pounds and thousands of dollars; that is, 000 omitted. Salt fish, except cod, has been converted to the equivalent of fresh fish]

Year	Washington		Oregon		California		Total	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
1888	23,721	811	26,268	734	41,255	2,465	91,244	4,010
1892	36,706	932	28,826	872	58,396	3,023	123,928	4,827
1895	59,158	1,402	38,197	1,284	50,524	1,787	147,879	4,473
1899	122,085	2,871	22,802	856	77,985	2,552	222,872	6,279
1904	88,954	2,973	27,534	1,185	57,024	2,523	173,512	6,681
1908	100,352	3,513	28,216	1,356	46,486	1,970	175,054	6,839
1915	158,546	5,321	34,693	1,479	88,981	2,506	282,220	9,306
1922	67,564	4,954	22,134	1,256	191,439	6,774	281,137	12,984
1923	111,261	7,801	32,883	3,504	260,804	7,737	404,948	19,012
1924	89,223	7,123	39,578	3,204	344,894	9,725	473,695	20,052
1925	130,687	9,477	40,008	3,442	440,301	11,662	610,996	24,581
1926	89,637	7,943	32,998	3,068	398,651	7,904	521,286	18,915
1927	125,655	9,146	34,195	3,103	491,347	10,058	651,197	22,307
1928	82,874	7,501	27,474	2,686	583,136	10,326	693,484	20,513

Fisheries of Washington, 1888 to 1928

CATCH

[Expressed in thousands of pounds; that is, 000 omitted. Salt fish, except cod, have been reduced to the equivalent of fresh fish]

Species	1888	1892	1895	1899	1904	1908
FISH						
Catfish				106	6	
Cod:						
Fresh	239		40			
Dry-salted		539	444	930	2,072	4,648
Flounders:						
"Sole"					9	190
Other		185	107	28	199	284
Halibut	1,520	1,410	1,844	6,861	12.066	30,072
Herring		617	345	424	532	2,506
"Lingcod"		359	223	91	144	62
Rockfishes		163	38	72	83	132
Sablefish		15	37	164	334	168
Salmon:						
Blueback or sockeye		2,514	7,313	42,071	11,507	12,501
Chinook		9,844	12,937	10,938	15,212	12,336
Chum	16,454	3,310	5,472	6,567	13,652	13,055
Humpback			2,270	21,112		
Silver		3,597	12,384	20,649	26,021	14,080
Shad		103		85	125	100
Smelt		322	528	937	1,370	2,897
Steelhead trout		2,419	4,971	1,507	1,859	2,339
Sturgeon		544	1,884	90	129	185
Surf fishes		65	169	43	149	661
Tomcod			10			
Other fish	1,135	40	30	49	78	
Total	19,348	26,046	51,046	112,724	85,547	96,212
SHELLFISH, ETC.						
Crabs	2	79	163	275	723	2,179
Shrimp	5	2	36	20	430	247
Clams:						
Hard	300	684	1,405	3,131	775	155
Razor					133	234
Oysters:						
Eastern, market					269	
Native, market	4,066	9,895	6,484	5,901	1,069	1,321
Japanese, market						
Mussels			24	19		
Total	4,373	10,660	8,112	9,346	3,399	4,136
WHALE PRODUCTS						
Whale oil				15		
Other whale products					8	
Total				15	8	
Grand total	23,721	36,706	59,158	122,085	88,954	100,352

Species	1915	1922	1923	1924	1925	1926	1927	1928
FISH								
Carp	200	375	384	379	286	659	922	557
Catfish			1					
Cod:								
Fresh	22				1		3	
Tongues							18	14
Dry salted	5,498	1,176	3,681	3,701	4,126	3,977	2,587	2,885
Flounders:								
"Sole"	68	131	120	266	231	205	224	223
Other	26	85	196	188	261	140	98	124
Grayfish							90	3
Halibut	40,591	18,467	24,151	15,330	18,516	17,850	10,713	11,928
Herring	2,129	260	425	183	670	2,822	812	1,537
"Lingcod"	837			477	695	823	1,017	997
Perch							60	75
Rockfishes	101	[1] 361	[1] 579	295	443	443	477	617
Sablefish	576	1,022	2,226	1,895	2,442	2,212	2,784	2,335

[1] Includes fresh cod and "lingcod."

Fisheries of Washington, 1888 to 1928—Continued

CATCH—Continued

[Expressed in thousands of pounds; that is, 000 omitted. Salt fish, except cod, have been converted to the equivalent of fresh fish]

Species	1915	1922	1923	1924	1925	1926	1927	1928
FISH—continued								
Salmon:								
Blueback or sockeye	5,043	5,104	3,664	5,053	10,212	3,726	7,814	4,672
Chinook	18,188	10,970	13,217	24,698	23,756	19,108	21,238	17,433
Chum	17,156	6,320	8,791	12,219	11,493	13,284	11,147	17,122
Humpback	29,998	145	33,097	498	35,309	128	41,370	1,261
Silver	18,630	14,817	12,950	16,158	15,195	15,410	15,643	13,350
Shad	96	48	89	193	255	380	326	515
Sharks	7,493	6	59	97	42	290		
Skates	229	4	7	10	1	4	1	2
Smelt	2,158	1,392	1,178	1,441	1,475	827	1,334	1,405
Steelhead trout	2,114	476	1,401	1,443	1,719	2,562	2,167	1,632
Sturgeon	44	268	84	86	120	85	81	84
Surf fishes	15	51	54	44	80	70		
Tomcod			1			1	(2)	
Other fish		[3] 2				[3] 26	23	20
Total	151,212	61,480	106,355	84,354	127,328	85,033	120,949	78,791
SHELLFISH, ETC.								
Crabs	1,734	1,172	1,154	1,146	952	1,938	1,711	1,521
Shrimp	386	62	35	38	36	51	39	36
Clams:								
Hard	176	92	80	203	222	215	250	215
Razor	373	949	381	524	893	1,288	1,859	1,535
Soft	1							
Oysters:								
Eastern, market	265	45	45	36	10	20	113	74
Native, market	350	555	682	651	663	698	616	615
Japanese, market		35	10	16	28	60		
Scallops				4	6	210	11	18
Octopus		20	52	105	106	124	102	63
Mussels	1							
Squid	15							
Trepang or sea cucumber							5	6
Other shellfish					4			
Total	3,401	2,930	2,439	2,723	2,920	4,604	4,706	4,083
WHALE PRODUCTS								
Sperm oil		261	347	68	87			
Whale oil	2,635	1,763	1,376	1,472	142			
Other whale products	1,298	1,130	744	606	210			
Total	3,933	3,154	2,467	2,146	439			
Grand total	158,546	67,564	111,261	89,223	130,687	89,637	125,655	82,874

[2] Less than 500 pounds. [3] Includes cod tongues.

Fisheries of Oregon, 1888 to 1928

CATCH

[Expressed in thousands of pounds; that is, 000 omitted. Salt fish have been converted to the equivalent weight of fresh fish]

Species	1888	1892	1895	1899	1904	1908
FISH						
Carp					20	30
Catfish			99	54	180	201
Flounders:						
"Sole"						
Other		10		4		23
Halibut		19	5	17	25	16
Herring				19	18	15
"Lingcod"		26	6			20
Rockfishes		86	47		21	5

Fisheries of Oregon, 1888 to 1928—Continued

CATCH—Continued

[Expressed in thousands of pounds; that is, 000 omitted. Salt fish have been converted to the equivalent weight of fresh fish]

	1888	1892	1895	1899	1904	1908
FISH—continued						
Salmon:						
Blueback or sockeye	24,481	3,140	566	579	334	403
Chinook		15,686	21,101	13,750	20,022	18,176
Chum			2,125	790	999	905
Silver		4,429	9,463	5,154	4,255	4,923
Shad	10	109	125	32	37	431
Smelt	180		31	28	25	30
Steelhead trout		2,587	3,220	1,104	1,104	2,469
Sturgeon	1,157	2,513	956		9	114
Surf fishes				6	4	26
Other fish	76				10	13
Total	25,904	28,605	37,744	21,537	27,063	27,800
SHELLFISH						
Crabs		4	24	111	246	200
Crawfish	14	20	59	116	187	178
Clams:						
Razor					31	
Hard	75	50	281	979		1
Soft						30
Oysters, native, market	275	147	89	59	7	7
Total	364	221	453	1,265	471	416
Grand total	26,268	28,826	38,197	22,802	27,534	28,216

Species	1915	1922	1923	1924	1925	1926	1927	1928
FISH								
Carp	50				63		68	13
Flounders:								
"Sole"					2	1	1	(1)
Other	2		5			4		
Halibut	235	239	864	511	578	363	372	426
Herring	12		94				54	(1)
"Lingcod"	13	21	78	52	59	16	68	62
Perch								3
Pilchard								(1)
Rockfishes	12	2	63	39	31	67	44	74
Sablefish	16	57	250	161	348	387	336	280
Salmon:								
Blueback or sockeye	337	936	2,065	436	353	805	237	152
Chinook	23,482	12,650	17,361	19,606	21,420	16,398	17,132	12,005
Chum	1,982	128	1,136	2,998	2,338	812	3,679	5,244
Silver	4,845	4,379	6,717	10,279	10,247	8,807	7,021	5,174
Shad	489	578	404	983	1,017	1,655	1,516	1,344
Smelt	4	217	277	227	309	73	412	19
Steelhead trout	2,366	1,821	2,856	3,605	2,307	2,657	2,196	1,814
Striped bass					6		2	13
Sturgeon	98	217	124	176	161	138	133	89
Surf fishes	12		15					
Tomcod	22		5					
Other fish	16	5						
Total	33,993	21,250	32,314	39,073	39,239	32,183	33,271	26,712
SHELLFISH								
Crabs	415	731	359	433	522	533	600	493
Crawfish	184	69	142	12	128	106	138	158
Clams:								
Razor	77	59	49	33	89	154	164	101
Hard				1		5		
Soft	22	14	5	15	20	14		
Mixed							[2] 19	10
Oysters, native, market	2	11	14	11	10	3	3	(1)
Total	700	884	569	505	769	815	924	762
Grand total	34,693	22,134	32,883	39,578	40,008	32,998	34,195	27,474

[1] Less than 500 pounds. [2] Consisted mostly of soft clams.

Fisheries of California, 1888 to 1928

CATCH

[Expressed in thousands of pounds; that is, 000 omitted. Salt fish, except cod, have been converted to the equivalent of fresh fish]

Species	1888	1892	1895	1899	1904	1908	1915	1918
FISH								
Albacore			299	179	210		21,074	7,265
Anchovies		150	460	7		220	113	868
Barracuda		436	1,245	1,425	2,375	3,205	3,923	4,838
Bonito		421	301	189	212	329	448	2,441
Carp		66	46	284	70	427	351	313
Catfish			277	466	737	1,069	517	205
Cod, salted		2,275	2,784	5,917	5,623	3,298	4,953	4,713
Flounders:								
"California halibut"								[1] 4,754
"Sole"				32	3,874		5,762	7,028
Other		4,270	3,308	4,715	4,361	[2] 6,681	6,934	2,574
Hake						32	269	219
Halibut								
Hardhead				186	65		73	28
Herring		4,487	3,181	1,653	1,426	825	864	7,938
Kingfish		40	148	127	174	682	656	975
"Lingcod"		231	139	148	293	167	578	916
Mackerel		350	95	168	135	197	266	4,076
Mullet				22	13	4	3	91
Pilchard or sardine		753	732	2,383	1,036	4,638	4,390	157,653
Pompano			11	13	34	89	19	24
Rock bass							901	784
Rockfishes		1,839	1,529	1,188	1,820	2,319	4,352	7,890
Sablefish						35	65	499
Salmon:								
Chinook		3,721	4,450	7,091	14,916	8,846	7,324	13,026
Silver		960	164	60	272	141	415	
Blueback				22	279	147		
Chum							38	
Sculpin				3	3		9	28
Sea bass:								
Black		263	37	96	63	161	392	249
White, squeteague			640	952	983	1,337	1,221	1,684
Shad		526	247	1,138	327	1,169	6,893	2,384
Sharks							68	403
Sheepshead								23
Skates					198	124	783	246
Skipjack, or striped tuna								3,024
Smelt		1,920	1,740	1,315	1,362	718	1,137	797
Steelhead trout		310	461	114	55	76	32	22
Striped bass		56	252	1,234	1,570	1,776	1,784	1,408
Sturgeon		718	300	206		10	18	
Surf fishes		[3] 335	[3] 267	116	119	198	128	198
Swordfish						8		18
Tomcod			64	376	69	49	42	49
Tuna:								
Yellowfin			32	24	15	12		
Mixed								6,241
Whitebait							56	136
Whitefish			263	58	270	466		
Yellowtail		546	316	334	358	571	1,343	11,798
Other fish	28,736	2,217	583	674	1,266	1,201	673	859
Total	28,736	26,890	24,371	32,915	44,583	41,227	78,867	258,685
SHELLFISH, ETC.								
Crabs	230	2,862	2,565	3,677	5,111	1,702	1,414	1,619
Sea crawfish or spiny lobster	231	303	558	607	1,078	573	892	931
Shrimp	4,902	5,313	5,425	6,495	2,576	258	298	722
Clams:								
Cockle								6
Pismo								166
Soft					140	468	67	52
Mixed	2,396	2,497	1,583	2,171	96	132	66	19
Mussels		2,880	488	364	28	68	19	8
Oysters:								
Eastern, market				25,200	1,120	729	376	136
Native, market	910	15,099	14,727	3,600	301		8	6
Abalone	[4] 3,606	[4] 405	[5] 126	369	[4] 825	1,005	731	121
Octopus	[6] 244	[6] 375	2				32	33
Scallops				4				

[1] Includes halibut.
[2] Includes "soles."
[3] Includes Sacramento perch.
[4] Includes shells.
[5] Dried.
[6] Includes squid.

Fisheries of California, 1888 to 1928—Continued

CATCH—Continued

Species	1888	1892	1895	1899	1904	1908	1915	1918
SHELLFISH, ETC.—continued								
Squid			30	1,869	754	110	6,211	362
Other shellfish								21
Total	12,519	29,734	25,504	44,356	12,029	5,045	10,114	4,202
WHALE PRODUCTS								
Sperm oil						169		
Whale oil		1,575	550	507	325	13		23
Other whale products		197	99	207	87	32		
Total		1,772	649	714	412	214		23
Grand total	41,255	58,396	50,524	77,985	57,024	46,486	88,981	262,910

Species	1919	1920	1921	1922	1923
FISH					
Anchovies	1,610	570	1,947	653	307
Barracuda	5,825	8,201	7,625	6,250	7,201
Carp	261	134	102	67	149
Catfish	165	112	148	126	129
Cod, salted	2,086	2,474	805	1,680	1,398
Flounders:					
"California halibut"	[1] 4,859	[1] 4,445	[1] 3,796	[1] 3,403	[1] 2,427
"Sole"	5,529	3,822	4,871	7,043	7,086
Other	1,148	1,204	1,078	1,712	1,874
Hake	133	142	90	75	79
Hardhead	49	13	76	18	10
Herring	4,290	274	542	342	384
Kingfish	609	461	391	582	412
"Lingcod"	1,063	688	426	568	467
Mackerel	2,703	3,048	2,975	2,496	3,592
Mullet	9	18	29	31	74
Pilchard or sardine	153,877	118,521	59,323	93,400	159,197
Pompano	61	30	17	16	33
Rock bass	450	210	364	316	357
Rockfishes	5,333	5,601	4,688	4,263	4,950
Sablefish	335	781	1,023	269	538
Salmon, chinook	13,146	11,134	7,991	7,235	7,090
Sculpin	25	36	58	42	60
Sea bass:					
Black	185	148	127	97	227
White, squeteague	2,520	2,661	2,643	2,982	2,520
Shad	1,574	1,410	863	1,110	1,285
Sharks	613	811	539	282	360
Sheepshead	18	15	24	18	32
Skates	253	89	60	121	134
Smelt	757	744	765	830	806
Steelhead trout	17	7	4	3	3
Striped bass	762	672	602	684	910
Surf fishes	191	181	243	238	326
Swordfish	18	13	15	23	12
Tomcod	31	37	42	32	42
Tuna and tunalike fishes:					
Albacore	13,631	18,877	15,277	13,232	12,515
Bluefin	14,991	10,530	2,032	2,838	3,301
Bonito	3,504	873	321	929	1,115
Skipjack, or striped tuna	6,897	7,957	1,139	11,862	11,463
Yellowfin	348	1,965	1,238	7,337	10,837
Yellowtail	5,005	2,705	2,491	3,414	3,980
Mixed	2,461	5,483	1,553	692	662
Whitebait	6	1	5	84	68
Whitefish	27	14	29	30	40
Other fish	655	681	1,359	280	237
Total	258,030	217,793	129,736	177,705	248,689
SHELLFISH, ETC.					
Crabs	1,305	1,221	801	860	1,076
Sea crawfish or spiny lobster	1,089	1,190	1,278	1,017	1,093
Shrimp	813	818	910	990	1,113
Abalone	152	180	298	312	318

[1] Includes halibut.

Fisheries of California, 1888 to 1928—Continued

CATCH—Continued

Species	1919	1920	1921	1922	1923
SHELLFISH, ETC.—continued					
Clams:					
Cockle	3	2	2	4	5
Pismo	104	75	55	49	59
Soft	50	39	36	57	47
Mixed	10	12	9	5	4
Mussels	6	6	2	7	10
Octopus	21	71	56	99	110
Oysters:					
Eastern, market	152	112	77	74	69
Native, market	14	9	1		
Squid	3,698	508	433	210	1,180
Other shellfish	270	97	4	13	1
Total	7,687	4,340	3,962	3,697	5,085
WHALE PRODUCTS					
Sperm oil		13	9	38	16
Whale oil	3,120	4,425	1,561	6,863	4,644
Other whale products	1,500	2,390	696	3,136	2,370
Total	4,620	6,828	2,266	10,037	7,030
Grand total	270,337	228,961	135,964	191,439	260,804

Species	1924	1925	1926	1927	1928
FISH					
Anchovies	347	124	60	368	357
Barracuda	7,129	8,006	5,022	6,200	6,452
Carp	76	95	72	63	157
Catfish	352	366	257	371	458
Cod, salted	2,884	3,416	3,712	2,747	2,597
Cod tongues					8
Eels				(7)	(7)
Flounders:					
"California halibut"	2,576	2,452	1,431	1,302	1,188
"Sole"	8,835	8,763	8,650	10,298	10,280
Other	2,081	2,551	1,813	1,468	1,517
Grayfish				325	624
Hake	61	22	58	85	109
Halibut	133	162	257	570	376
Hardhead	19	24	44	33	62
Herring	436	866	454	1,168	1,140
Horse mackerel				467	540
Kingfish	384	537	485	529	442
"Lingcod"	400	683	645	555	849
Mackerel	3,241	3,522	3,623	4,741	35,262
Mullet	62	37	52	40	83
Perch				263	237
Pilchard or sardine	242,686	315,295	286,741	342,275	420,270
Pompano	18	11	8	55	30
Rock bass	466	330	636	526	626
Rockfishes	4,717	5,454	7,538	6,377	6,420
Sablefish	933	722	183	992	917
Salmon, chinook	10,015	9,526	6,084	6,512	4,479
Sculpin	109	226	108	114	100
Sea bass:					
Black	231	189	378	468	382
White, squeteague	1,516	1,920	2,216	2,273	1,281
Shad	1,539	2,440	903	4,104	2,089
Sharks	393	372	507		
Sheepshead	24	49	139	159	373
Skates	131	183	233	263	459
Smelt	722	752	883	966	917
Splittail				11	11
Squawfish				8	4
Steelhead trout	87				
Striped bass	662	838	751	648	484
Stingray					3
Suckers				1	1
Surf fishes	289	268	209		
Swordfish	32	27	46	130	426
Tomcod	43	15	4	1	12

[7] Less than 500 pounds.

Fisheries of California, 1888 to 1928—Continued

CATCH—Continued

Species	1924	1925	1926	1927	1928
FISH—continued					
Tuna and tunalike fishes:					
Albacore	17,695	22,207	2,469	4,579	283
Bluefin	3,241	3,804	6,527	4,899	13,701
Bonito	1,038	867	3,079	1,717	2,088
Skipjack, or striped tuna	3,781	14,235	20,995	33,807	15,815
Yellowfin	3,063	13,238	12,565	25,934	32,251
Yellowtail	4,714	3,180	5,023	4,225	2,683
Mixed	547	427	261		
Whitebait	122	71	86	134	135
Whitefish	273	222	368	313	222
Other fish	377	253	482	207	196
Total	328,480	428,747	386,057	473,291	569,396
SHELLFISH, ETC					
Crabs	1,507	3,234	3,296	2,960	3,575
Sea crawfish or spiny lobster	1,027	1,486	1,175	1,491	1,077
Shrimp	1,551	1,460	1,432	1,697	2,281
Abalone	449	471	412	563	421
Clams:					
Cockle	1		2	1	3
Pismo	73	81	69	33	31
Soft	41	44	41	25	25
Mixed	7	9	5	[8] 10	7
Mussels	8	4	1	3	(7)
Octopus	166	133	63	37	6
Oysters:					
Eastern, market	53	57	61	56	73
Native, market					4
Squid	6,831	1,891	3,136	6,014	1,352
Terrapin					(7)
Turtles					5
Total	11,714	8,870	9,693	12,890	8,860
WHALE PRODUCTS					
Sperm oil		49	37		
Whale oil	2,932	1,526	1,980	5,166	4,880
Other whale products	1,768	1,109	883		
Total	4,700	2,684	2,900	5,166	4,880
Grand total	344,894	440,301	398,650	491,347	583,136

[7] Less than 500 pounds.

[8] Consisted mostly of soft clams.

HALIBUT FISHERY OF THE PACIFIC COAST [9]

UNITED STATES AND CANADA

The halibut fishery of the Pacific coast, which is prosecuted by United States and Canadian vessels, ranks as one of the foremost fisheries of that section. In 1929 the total weight of the catch landed by vessels of both nationalities amounted to 55,490,000 pounds, valued at $6,698,000. This is virtually the same as the amount of

[9] To preclude the possibility of unwarranted comparison of figures given in this section with others for years previous to 1927, it should be explained that the figures as herein compiled differ from those published in separate reports for the Alaska fisheries and the Pacific Coast States. The difference lies principally in the fleet classifications as between Washington and Alaska, though there is reason to believe that the figures on landings also are not comparable with those previously published, due to variable practice in the inclusion of United States caught halibut landed at foreign ports as well as the possible duplication of figures.

The present compilation is a complete résumé of the landings of the United States fleet for the year 1929 at all Pacific ports except those in Oregon and California, without omission or duplication. The fleet classification has been applied arbitrarily by including in the "Washington fleet" all vessels that land more than half of their catch in that State. All others were included in the "Alaska fleet." It has been necessary to use "hailing fares" for the weight of the landings at Seattle, Wash., and Prince Rupert, British Columbia, although the error therefrom is estimated to be less than 2 per cent. The Alaska data are based on actual weight of the fares. Halibut are landed head on, but eviscerated.

the catch in 1928 and but little more than that for 1925, 1926, or 1927. Of this amount, 84 per cent was taken by United States craft and 16 per cent by Canadian craft. Of the total catch, 53 per cent was landed in British Columbia. Owing to Prince Rupert, British Columbia, having excellent rail facilities with western points of Canada and the United States, and being in close proximity to the fishing grounds, the majority of the British Columbia landings were made there. The rest of them were made at Vancouver and Victoria, British Columbia. Twenty-two per cent of the total catch was landed at ports in the State of Washington and 25 per cent at ports in Alaska.

UNITED STATES

Operating units.—The halibut fleet of the United States numbered 226 vessels that fished regularly for halibut; their total net tonnage was 5,474, they were manned by 1,494 fishermen, and operated 9,440 skates of lines. In addition to the regular vessels, 91 other vessels and 87 boats landed halibut at times. These used 3,286 skates of lines.

Catch.—The total weight of the catch as landed by all United States craft fishing for halibut amounted to 50,834,190 pounds, valued at $5,952,097. Of this amount, 92 per cent consisted of halibut, 5 per cent of sablefish, 2 per cent of "lingcod," and 1 per cent of rockfishes. The regular halibut vessels made 91 per cent of the total catch, while the casual vessels and boats in this fishery caught the rest, or 9 per cent.

Halibut fishery of the Pacific coast, 1929

UNITED STATES OPERATING UNITS: BY FLEET CLASSIFICATION

Items	Washington fleet	Alaska fleet	Total
Regular halibut vessels:			
Number	57	169	226
Net tonnage	1,342	4,132	5,474
Crew	371	1,123	1,494
Dories	57	169	226
Skates of lines	2,510	6,930	9,440
Vessels in other fisheries but landing one or more fares of halibut:			
Number	41	50	91
Net tonnage	628	742	1,370
Crew	202	188	390
Dories	25	32	57
Skates of lines	1,515	1,080	2,595
Regular halibut boats:			
Number		11	11
Crew		29	29
Skates of lines		220	220
Boats in other fisheries but landing one or more fares of halibut:			
Number	2	74	76
Crew	4	134	138
Skates of lines	30	441	471

Halibut fishery of the Pacific coast, 1929—Continued

CATCH OF ALL SPECIES: BY UNITED STATES VESSELS AND BOATS

Fleet classification	Landed in—						Total	
	Washington		British Columbia		Alaska			
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
WASHINGTON FLEET								
Regular vessels:								
Halibut	6,569,350	$980,653	777,700	$97,554	354,970	$35,228	7,702,020	$1,113,435
Sablefish	1,933,050	118,835			1,753	130	1,934,803	118,965
"Lingcod"	616,435	24,070					616,435	24,070
Rockfishes	339,825	14,604					339,825	14,604
Total	9,458,660	1,138,162	777,700	97,554	356,723	35,358	10,593,083	1,271,074
Other vessels and boats:								
Halibut	1,153,370	164,859	196,700	23,768	12,956	1,445	1,363,026	190,072
Sablefish	139,800	8,163					139,800	8,163
"Lingcod"	261,550	8,655					261,550	8,655
Rockfishes	116,100	4,778					116,100	4,778
Total	1,670,820	186,455	196,700	23,768	12,956	1,445	1,880,476	211,668
ALASKA FLEET								
Regular vessels:								
Halibut	4,600,950	640,428	18,712,200	2,308,918	11,607,737	1,204,631	34,920,887	4,153,977
Sablefish	209,000	12,476			340,988	17,454	549,988	29,930
"Lingcod"	189,250	9,233			10,755	322	200,005	9,555
Rockfishes	100,150	4,597			17,833	1,021	117,983	5,618
Total	5,099,350	666,734	18,712,200	2,308,918	11,977,313	1,223,428	35,788,863	4,199,080
Other vessels and boats:								
Halibut	116,000	21,170	561,900	65,139	1,858,211	182,319	2,536,111	268,628
Sablefish	1,000	70			23,874	1,269	24,874	1,339
"Lingcod"					1,580	44	1,580	44
Rockfishes					9,203	264	9,203	264
Total	117,000	21,240	561,900	65,139	1,892,868	183,896	2,571,768	270,275
BOTH FLEETS								
Regular vessels:								
Halibut	11,170,300	1,621,081	19,489,900	2,406,472	11,962,707	1,239,859	42,622,907	5,267,412
Sablefish	2,142,050	131,311			342,741	17,584	2,484,791	148,895
"Lingcod"	805,685	33,303			10,755	322	816,440	33,625
Rockfishes	439,975	19,201			17,833	1,021	457,808	20,222
Total	14,558,010	1,804,896	19,489,900	2,406,472	12,334,036	1,258,786	46,381,946	5,470,154
Other vessels and boats:								
Halibut	1,269,370	186,029	758,600	88,907	1,871,167	183,764	3,899,137	458,700
Sablefish	140,800	8,233			23,874	1,269	164,674	9,502
"Lingcod"	261,550	8,655			1,580	44	263,130	8,699
Rockfishes	116,100	4,778			9,203	264	125,303	5,042
Total	1,787,820	207,695	758,600	88,907	1,905,824	185,341	4,452,244	481,943
All vessels and boats:								
Halibut	12,439,670	1,807,110	20,248,500	2,495,379	13,833,874	1,423,623	46,522,044	5,726,112
Sablefish	2,282,850	139,544			366,615	18,853	2,649,465	158,397
"Lingcod"	1,067,235	41,958			12,335	366	1,079,570	42,324
Rockfishes	556,075	23,979			27,036	1,285	583,111	25,264
Grand total	16,345,830	2,012,591	20,248,500	2,495,379	14,239,860	1,444,127	50,834,190	5,952,097

Halibut fishery of the Pacific coast, 1929—Continued

CATCH OF HALIBUT: BY UNITED STATES AND CANADIAN VESSELS AND BOATS

[Expressed in thousands of pounds and thousands of dollars; that is, 000 omitted]

Fleet classification	Landed in—						Total	
	Washington		British Columbia		Alaska			
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
WASHINGTON FLEET								
Regular halibut vessels	6,569	981	778	98	355	35	7,702	1,114
Other vessels or boats	1,153	165	197	24	13	1	1,363	190
Total	7,722	1,146	975	122	368	36	9,065	1,304
ALASKA FLEET								
Regular halibut vessels	4,601	640	18,712	2,309	11,608	1,205	34,921	4,154
Other vessels or boats	116	21	562	65	1,858	182	2,536	268
Total	4,717	661	19,274	2,374	13,466	1,387	37,457	4,422
COMBINED FLEETS								
Regular halibut vessels	11,170	1,621	19,490	2,407	11,963	1,240	42,623	5,268
Other vessels and boats	1,269	186	759	89	1,871	183	3,899	458
Total	12,439	1,807	20,249	2,496	13,834	1,423	46,522	5,726
British Columbia fleet			8,960	[1] 971	8	1	8,968	972
Grand total	12,439	1,807	29,209	3,467	13,842	1,424	55,490	6,698

[1] Estimated.

Halibut fishery of the Pacific coast, 1925–1929

[Expressed in thousands of pounds; that is, 000 omitted]

Year	Landed in—							Total		Grand total
	Washington: by U. S. vessels	British Columbia			Alaska					
		By U. S. vessels	By Canadian vessels	Total	By U. S. vessels	By Canadian vessels	Total	By U. S. vessels	By Canadian vessels	
1925	9,685	22,390	7,731	30,121	10,038		10,038	42,113	7,731	49,844
1926	10,050	20,331	9,277	29,608	14,122		14,122	44,503	9,277	53,780
1927	11,789	18,258	10,076	28,334	15,052		15,052	45,099	10,076	55,175
1928	13,753	19,963	11,396	31,359	9,733	70	9,803	43,449	11,466	54,915
1929	12,439	20,249	8,960	29,209	13,834	8	13,842	46,522	8,968	55,490

NOTE.—Statistics for Washington are furnished by the Seattle Halibut Exchange, those for British Columbia by the U. S. Consular Service and the Prince Rupert Halibut Exchange, and those for Alaska by bureau agents.

VESSEL FISHERIES AT SEATTLE, WASH.

During 1929 a total of 39,671,083 pounds of fishery products, valued at $4,029,074, were handled by Seattle wholesale dealers, exclusive of amounts received by transporting vessels or rail from Alaska or Canada. This is an increase over the previous year by 17 per cent in amount, and 28 per cent in value and was due mainly to the larger quantities of salmon handled.

Of the total amount handled, 16,257,405 pounds of fish valued at $1,996,468, were landed by fishing vessels which made 1,128 trips to the fishing grounds. This is a decrease of 37 trips and 7 per cent in amount compared with the previous year, but an increase of 14 per cent in value. Halibut was the most important species taken by fishing vessels, accounting for 76 per cent of the catch. Sablefish accounted for 14 per cent; "lingcod," 6 per cent, and rockfishes, 4 per cent of the total catch. In addition, 125 pounds of octopus, valued at $9 were landed.

The catch by fishing vessels was taken from fishing grounds along the Pacific coast from points off Oregon to Wosnesenski Island, Alaska. Hecate Straits ranked as the most important grounds, 35 per cent of the catch being made there. Second in importance was Cape Flattery, which provided 26 per cent of the catch, while Portlock Bank ranked third, furnishing 10 per cent. The remainder of the catch was taken mainly on fishing grounds west of longitude 145° W.

Most of the catch by fishing vessels was made during the nine months from March to November, inclusive, which is due mainly to the closed season on the taking of halibut from November 15 to February 15. During each of the above months the landings averaged about 1,700,000 pounds.

During 1929, 23,413,678 pounds of fishery products, valued at $2,032,606, were received by wholesale fish dealers from sources other than Alaska or Canada, or from vessels in the halibut fishery discussed above. Most of these were taken in Puget Sound. This was 44 per cent more than the amount received from similar sources in 1928 by Seattle wholesale dealers, and the value was 46 per cent greater. The increase in amount and value was due principally to the larger amount of salmon which was handled, the year 1929 being a "good" year for the salmon run.

Of the total fishery products handled by wholesale fish dealers derived from sources other than the halibut fleet or from Alaska or Canada, salmon accounted for 90 per cent, and the remainder consisted largely of such species as crabs, herring, sablefish, flounders, smelt, and "lingcod."

During the months of July, August, September, and October, inclusive, Seattle wholesale dealers had their busiest season, as the transactions during these months accounted for 74 per cent of the trade other than with the halibut fleet.

Fishery products landed by United States fishing vessels at Seattle, Wash., 1929 [1]

BY BANKS

Fishing grounds	Trips	Halibut				Sablefish	
		No. 1		No. 2			
West of 145° W. longitude	*Number*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Wosnesenski Island	1	37,000	$5,550	13,000	$1,560		
Shumagin Islands	2	27,500	4,134	19,000	2,365		
Chirikof Island	6	207,000	30,287	87,500	9,500		
Trinity Island	11	267,000	39,054	147,800	18,433		
Albatross Bank	14	434,500	62,490	136,500	15,225		
Kodiak Bank	5	138,000	21,584	67,000	8,130		
Portlock Bank	41	1,175,300	166,594	399,700	47,986		
Cook Inlet	3	79,000	11,721	40,000	4,530		
Pye Island	1	43,000	6,558	5,000	600		
Cape Cleare	10	227,000	34,492	78,000	8,920		
Brooks Bay	1					60	$4
Middleton Island	8	193,700	28,115	64,300	7,786		

[1] Halibut fleet.

Fishery products landed by United States fishing vessels at Seattle, Wash., 1929—Continued

BY BANKS—Continued

Fishing grounds	Trips	Halibut				Sablefish	
		No. 1		No. 2			
	Number	*Pounds*	*Values*	*Pounds*	*Value*	*Pounds*	*Value*
North of Cape Ommaney							
Cape St. Elias	2	46,000	$6,412	13,000	$1,320		
Icy Bay	5	110,200	15,776	31,800	3,716	4,000	$280
Yakutat Bank	14	347,700	50,278	108,300	13,041		
Cape Fairweather	11	298,000	43,702	78,500	9,141		
Cape Spencer	1	17,000	2,401	25,000	3,000		
Cross Sound	1	13,000	1,901	2,000	240	1,000	20
W. Bank	3	82,500	11,827	21,500	2,708		
Cape Ommaney	2	18,300	2,937	14,200	1,716	2,000	140
Inside Alaskan waters	1	3,500	551			1,500	105
South of Cape Ommaney							
Cape Addington	7	41,500	6,842	251,500	32,765		
Forrester Island	2	8,200	1,521	1,300	182	13,000	700
Hecate Straits	478	2,574,600	421,592	2,450,000	319,140	283,250	15,205
Goose Island	5	17,500	2,459	56,500	6,530		
Triangle Island	1	1,300	286	200	28	400	16
Quatsino	1						
Nootka Sound	1						
Estavan	6						
West coast, Vancouver Island (general)	19	34,200	6,566	8,800	1,095	600	12
Cape Flattery	428	984,570	171,992	633,600	83,264	1,664,200	102,735
Oregon coast	37	130,300	24,110	47,800	7,114	281,400	18,675
Total	1,128	7,557,370	1,181,732	4,801,800	610,035	2,251,410	137,892

Fishing grounds	"Lingcod"		Rockfishes		Octopus		Total	
West of 145° W. longitude	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Wosnesenski Island							50,000	$7,110
Shumagin Islands							46,500	6,499
Chirikof Island							294,500	39,787
Trinity Island							414,800	57,487
Albatross Bank							571,000	77,715
Kodiak Bank	500	$25	1,500	$75			207,000	29,814
Portlock Bank							1,575,000	214,580
Cook Inlet							119,000	16,251
Pye Island							48,000	7,158
Cape Cleare							305,000	43,412
Brooks Bay	13,000	826	10,000	712			23,060	1,542
Middleton Island							258,000	35,901
North of Cape Ommaney								
Cape St. Elias							59,000	7,732
Icy Bay							146,000	19,772
Yakutat Bank							456,000	63,319
Cape Fairweather							376,500	52,843
Cape Spencer							42,000	5,401
Cross Sound							16,000	2,161
W. Bank							104,000	14,535
Cape Ommaney	500	15	2,000	100			37,000	4,908
Inside Alaskan waters							5,000	656
South of Cape Ommaney								
Cape Addington	200	8	2,800	127			296,000	39,742
Forrester Island			1,000	30			23,500	2,433
Hecate Straits	197,600	5,884	197,850	7,356			5,703,300	769,177
Goose Island	3,200	79					77,200	9,068
Triangle Island	9,000	360					10,900	690
Quatsino	6,000	360	4,500	270			10,500	630
Nootka Sound	2,000	182	3,000	275			5,000	457
Estavan	31,000	2,368	18,000	1,299	125	$9	49,125	3,676
West coast, Vancouver Island (general)	102,800	6,677	55,200	3,385			201,600	17,735
Cape Flattery	661,000	22,739	260,850	10,945			4,204,220	391,675
Oregon coast	42,900	1,829	20,300	874			522,700	52,602
Total	1,069,700	41,352	577,000	25,448	125	9	16,257,405	1,996,468

Fishery products landed by United States fishery vessels at Seattle, Wash., 1929—Continued

BY MONTHS

Months	Trips	Halibut				Sablefish	
		No. 1		No. 2			
	Number	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
January	11						
February	46	213,800	$34,159	58,300	$7,122	7,360	$198
March	114	921,350	147,844	342,550	42,426	43,900	2,070
April	165	1,233,000	175,705	790,100	95,640	41,550	1,655
May	144	872,900	130,238	724,600	84,978	36,900	1,930
June	139	782,200	119,793	682,900	80,762	196,400	11,134
July	85	563,500	94,944	522,250	70,318	164,900	8,547
August	106	777,350	123,105	653,600	83,567	332,500	17,347
September	96	577,320	98,156	468,250	67,278	327,400	18,924
October	104	455,550	85,664	200,250	31,430	649,700	44,627
November	99	1,160,400	172,124	359,000	46,514	440,300	30,626
December	19					10,500	834
Total	1,128	7,557,370	1,181,732	4,801,800	610,035	2,251,410	137,892

Months	"Lingcod"		Rockfishes		Octopus		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
January	86,500	$5,587	49,500	$3,143			136,000	$8,730
February	95,650	5,746	56,950	3,392	125	$9	432,185	50,626
March	71,000	3,925	38,050	2,303			1,416,850	198,568
April	182,200	4,558	48,650	1,903			2,295,500	279,461
May	108,350	1,917	74,350	2,255			1,817,100	221,318
June	109,500	2,327	53,750	1,666			1,824,750	215,682
July	40,800	918	30,100	1,226			1,321,550	175,953
August	27,800	1,142	43,700	1,783			1,834,950	226,944
September	67,500	2,371	65,700	2,603			1,506,170	189,332
October	94,650	3,771	34,600	1,283			1,434,750	166,775
November	96,100	4,598	20,500	986			2,076,300	254,848
December	89,650	4,492	61,150	2,905			161,300	8,231
Total	1,069,700	41,352	577,000	25,448	125	9	16,257,405	1,996,468

Fishery products received by Seattle wholesale dealers, by months, 1929 [1]

Species	January		February		March		April		May	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Salmon:										
Sockeye or red									4,921	$738
King or spring	184	$18			5,000	$1,500	266,466	$60,693	933,283	130,660
Coho or silver	422	30							99,834	5,990
Chum or keta	21,392	2,139							80	4
Trout, steelhead	8,031	1,446	25,800	$4,644	4,000	720			25,196	3,024
Rockfishes	6,500	390	5,760	298	8,200	574	971	48	3,037	197
"Lingcod"			4,525	207	5,200	208	4,840	168	1,791	36
Flounders:										
"Sole"	55,000	2,200	29,375	1,169	27,300	1,052	34,959	1,452	18,754	792
Other	8,000	160	267	9	400	16				
Herring					525,400	2,971				
Smelt	8,000	1,040							722	72
Perch	7,000	490	4,821	58	6,300	378	4,330	216		
Sturgeon									70	10
Octopus			162	8			1,910	95	45	3
Crabs	30,800	2,800	37,400	1,838	25,300	1,360	13,376	608	19,910	905
Total	145,329	10,713	108,110	8,231	607,100	8,779	326,852	63,280	1,107,643	142,431

[1] Prior to the month of July, 1929, the above table was titled "Fishery products landed by collecting vessels at Seattle, Wash. (taken in Puget Sound)." This has been changed to the present title, "Fish received by Seattle wholesale dealers," due to the fact that fish received by Seattle wholesalers comes from local sources other than Puget Sound. It does not include fish received from Alaska or Canada, or vessels in the halibut fleet.

Fishery products received by Seattle wholesale dealers, by months, 1929—Contd.

Species	June		July		August		September	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Salmon:								
Sockeye or red	3, 715	$483	57, 576	$8, 993	57, 079	$7, 749	6, 265	$895
King or spring	1, 586, 956	202, 968	2, 655, 427	324, 490	2, 243, 983	294, 065	407, 209	47, 551
Coho or silver	209, 769	20, 977	905, 227	76, 885	864, 151	67, 130	1, 210, 967	104, 416
Humpback or pink	590	30	77, 012	3, 143	2, 786, 209	121, 948	339, 194	16, 480
Chum or keta	515	41	9, 265	417	113, 834	5, 120	135, 903	5, 441
Trout, steelhead	9, 682	968	7, 808	968	2, 245	269	3, 536	422
Rockfishes	13, 687	273	12, 301	405	14, 035	688	7, 457	287
"Lingcod"	8, 621	172	22, 413	724	24, 580	702	12, 682	347
Flounders:								
"Sole"	10, 740	451	16, 889	709	21, 391	452	10, 606	318
Other			723	7	283	3	195	4
Halibut			1, 830	327	620	93		
Herring			16, 000	80			470	5
Smelt	270	27	3, 448	469	19, 621	2, 747	39, 299	5, 572
Perch					497	25	959	48
Sablefish							148, 733	8, 704
Sturgeon	215	22	4, 243	757	10, 551	1, 769	8, 600	1, 370
Octopus			57	2			30	2
Crabs	8, 448	384						
Total	1, 853, 208	226, 796	3, 790, 219	418, 376	6, 159, 079	502, 760	2, 332, 105	191, 862

Species	October		November		December		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Salmon:								
Sockeye or red	2, 993	$792					132, 549	$19, 650
King or spring	35, 844	4, 269	25, 234	$3, 020	14, 907	$1, 789	8, 174, 493	1, 071, 023
Coho or silver	1, 094, 780	120, 913	211, 390	23, 436	7, 378	883	4, 603, 918	420, 660
Humpback or pink	900	37					3, 203, 905	141, 638
Chum or keta	3, 616, 633	182, 346	979, 841	47, 851	123, 731	7, 641	5, 001, 194	251, 000
Trout, steelhead	1, 268	149	395	45	551	56	88, 512	12, 711
Rockfishes	10, 110	687	2, 246	67	1, 040	42	85, 344	3, 956
"Lingcod"	25, 791	1, 289	552	26	50	2	111, 045	3, 881
Flounders:								
"Sole"	17, 479	416	21, 521	4, 133	22, 990	876	287, 004	14, 020
Other							9, 868	199
Halibut							2, 450	420
Herring	5, 375	54					547, 245	3, 110
Smelt	37, 809	5, 594	21, 279	2, 907	11, 481	1, 575	141, 929	20, 003
Perch	365	18	673	39	331	13	25, 276	1, 285
Sablefish	212, 170	14, 852	1, 200	72	1, 685	118	363, 788	23, 746
Sturgeon	922	129			159	24	24, 760	4, 081
Octopus	57	3	108	5			2, 369	118
Crabs	88, 234	7, 520	240, 219	17, 478	144, 342	8, 212	[2] 608, 029	41, 105
Total	5, 150, 730	339, 068	1, 504, 658	99, 079	328, 645	21, 231	23, 413, 678	2, 032, 606

[2] 27,637 dozen.

LAKE FISHERIES [10]

UNITED STATES AND CANADA

In 1928 the total catch of the lake fisheries of the United States and Canada amounted to 92,913,909 pounds. This represents a decrease of 17 per cent as compared with the catch in 1927. Of the total catch, that taken in the United States amounted to 63,368,467 pounds, valued at $5,960,784. This represents 68 per cent of the total catch of the lake fisheries. It is a decrease of 22 per cent as compared with the previous year's catch. The Canadian catch, which amounted to 29,545,442 pounds, shows a decrease of 4 per cent as compared with the catch in the previous year.

CATCH

By species.—The statistics of the catch in the United States and Canada in 1928 show that lake herring ranked first in quantity of production among species of fish taken in the lake fisheries. The catch in 1928 amounted to 18,953,179 pounds, which is 20 per cent of the total production for all the lake fisheries. This represents a decrease of 26 per cent as compared with catch of the previous year. The catch of lake herring in the United States accounted for 79 per cent of the total. Lake trout ranked second in importance with a catch of 15,833,038 pounds and represents 17 per cent of the total production. The catch shows a decrease of 10 per cent as compared with that in the previous year. About 60 per cent of the trout were taken in the waters of the United States. Common whitefish ranked third in importance with a catch of 10,823,440 pounds, or 12 per cent of the total. This is an increase of 6 per cent as compared with the catch of the previous year. About 59 per cent of the catch was taken in United States waters. The catch of yellow perch, 56 per cent of which were taken in the waters of the United States, amounted to 10,381,960 pounds. This is an increase of 34 per cent as compared with the catch in 1927. The catch of blue pike, about 69 per cent of which were taken in the waters of the United States, amounted to 6,987,331 pounds. This is a decrease of 33 per cent as compared with the catch of 1927. The catch of cisco in Lake Erie, amounted to

[10] The most recent complete statistical canvass made by the bureau for the American catch in the lake fisheries (Lakes Ontario, Erie, Huron, Michigan, Superior, St. Clair, Kabetogama, Namakan, and Sand Point, Lake of the Woods, and Rainy Lake) was for the year 1922. The statistics collected in this canvass are published in condensed form in Bureau of Fisheries Statistical Bulletin No. 618 and in full in the report of the division of fishery industries for 1923.

The statistics of the catch presented herewith for 1928 were obtained from the various State fisheries agencies and Dominion of Canada reports while statistics of the operating units (fishermen, vessels, boats, and gear) actually fished in 1928 were obtained by the bureau in a special canvass. In this latter canvass the catch, segregated as to method of taking, was not ascertained.

Statistics in the tables for the years 1913 to 1928 are for Lakes Ontario, Erie, Huron, Michigan, Superior, Namakan, Lake of the Woods, and Rainy Lake. Those for the years 1913 to 1924 were obtained in a survey of the lake fisheries made by the United States Tariff Commission, while those for the years 1925 to 1928, inclusive, were compiled and supplemented by the bureau from State statistics. To complete the data for the various lakes there have been included statistics of the Canadian lake fisheries for the years 1913 to 1928, which were obtained from official reports of the Dominion of Canada. The statistics shown for the years 1913 to 1925 are exclusive of the production of Illinois. The disparity resulting from the noninclusion of the production of Illinois is negligible. The production of Indiana from 1913 to 1925 has been estimated. The statistics from 1926 to 1928, inclusive, of the fisheries of these two States were collected by the bureau, which permits of their inclusion with the statistics collected by New York, Pennsylvania, Ohio, Michigan, Wisconsin, and Minnesota.

In all cases the statistics collected are for the calendar year, except for Lake of the Woods and Rainy Lake, and Lake Namakan in Minnesota, which are for two seasons. For Lake of the Woods the seasons are from June 1 to November 1 and December 1 to April 1, and for Rainy and Namakan Lakes from May 15 to November 1 and December 1 to April 1. The catch for these two seasons, in the order named, have been combined to constitute a year. The quantity of fish taken in these lakes between January 1 and April 1 amounted to less than 3 per cent of the total catch of these lakes in 1927.

only 1,891,328 pounds in 1928. About 67 per cent of the catch was made in Canadian waters. The catch of this species represents a decrease of 59 per cent as compared with the previous year, and a large decrease as compared with the catches of this fish that were formerly made on Lake Erie.

By lakes.—Statistics of the production in the United States and Canada in 1928, by lakes, shows that Lake Erie ranked as the most important, with a catch of 30,110,270 pounds. This is a decrease of 11 per cent as compared with the catch in the previous year. Lake Superior ranked second in importance, the catch amounting to 18,532,835 pounds. This is a decrease of 9 per cent as compared with the catch in the previous year. Lake Michigan ranked third, with a catch amounting to 17,998,657 pounds. This is a decrease of 24 per cent compared with the catch in the previous year. The catch of Lake Huron amounted to 17,828,128 pounds, which is a decrease of 27 per cent as compared with that in the previous year. The catch in Lake Ontario amounted to 4,444,547 pounds, which is a decrease of 2 per cent as compared with the previous year. The catch in Lake of the Woods, Rainy Lake, and Namakan Lake, amounted to 3,999,472 pounds, which is a decrease of 17 per cent as compared with that in the previous year.

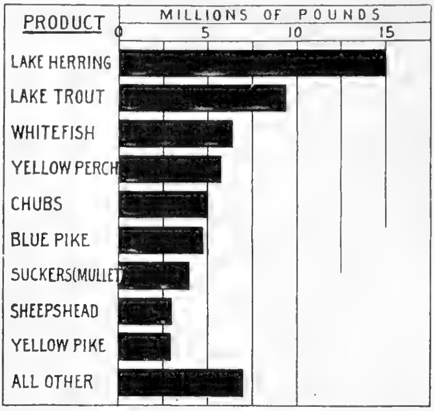

FIGURE 25.—Yield of principal fishery products in the Lakes fisheries, 1928

Lake Fisheries of the United States and Canada, 1928

CATCH: BY LAKES

Species	Lake Ontario			Lake Erie		
	United States	Canada	Total	United States	Canada	Total
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Blue pike	23, 728	14, 000	37, 728	4, 818, 792	2, 103, 800	6, 922, 592
Burbot	64, 232	([1])	[1] 64, 232	410, 722	([1])	[1] 410, 722
Carp	18, 365	120, 600	138, 965	918, 650	214, 900	1, 133, 550
Catfish and bullheads	40, 729	112, 500	153, 229	266, 714	53, 300	320, 014
Cisco				618, 028	1, 273, 300	1, 891, 328
Lake herring	342, 187	705, 800	1, 047, 987			
Lake trout	43, 223	806, 000	849, 223	2, 801	100	2, 901
Pike (jacks)		132, 000	132, 000	647	15, 000	15, 647
Sauger pike				1, 502, 325	([1])	[1] 1, 502, 325
Sheepshead				2, 919, 593	([1])	[1] 2, 919, 593
Sturgeon	19, 595	7, 800	27, 395	7, 613	215, 800	223, 413
Sucker, "mullet"	70, 815	([1])	[1] 70, 815	1, 318, 238	([1])	[1] 1, 318, 238
White bass				285, 179	([1])	[1] 285, 179
Whitefish, common	115, 793	1, 068, 400	1, 184, 193	974, 469	987, 900	1, 962, 369
Yellow perch	44, 679	163, 400	208, 079	4, 273, 987	4, 330, 400	8, 604, 387
Yellow pike	19, 840	33, 400	53, 240	1, 308, 420	182, 000	1, 490. 420
Miscellaneous	50, 661	426, 800	477, 461	16, 992	1, 090, 600	1, 107, 592
Total	853, 847	3, 590, 700	4, 444, 547	19, 643, 170	10, 467, 100	30, 110, 270

[1] The Canadian catch of these species has been included under "Miscellaneous."

Lake Fisheries of the United States and Canada, 1928—Continued

CATCH: BY LAKES—Continued

Species	Lake Huron			Lake Michigan	Lake Superior		
	United States	Canada	Total	United States	United States	Canada	Total
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Blue pike	-----	1,000	1,000	-----	-----	-----	-----
Burbot	2,088	(1)	[1] 2,088	30,206	-----	-----	-----
Carp	282,592	56,600	339,192	11,082	2,785	1,000	3,785
Catfish and bullheads	171,042	5,800	176,842	1,634	213	-----	213
Chubs	427,250	643,700	1,070,950	3,751,990	641,808	3,700	645,508
Lake herring	2,709,041	339,700	3,048,741	3,032,758	8,853,693	2,970,000	11,823,693
Lake trout	1,597,851	3,680,800	5,278,651	4,818,723	2,955,048	1,914,200	4,869,248
Pike (jacks)	19,759	106,300	126,059	107,479	11,222	8,800	20,022
Sauger pike	46,093	(1)	[1] 46,093	7,994	1,772	(1)	[1] 1,772
Sheepshead	12,742	(1)	[1] 12,742	1,602	-----		-----
Sturgeon	15	109,500	109,515	1,673	-----	1,200	1,200
Sucker, "mullet"	1,873,049	(1)	[1] 1,873,049	456,349	144,886	(1)	[1] 144,886
White bass	613	(1)	[1] 613	-----	-----	-----	-----
Whitefish, common	1,468,801	1,792,500	3,261,301	3,525,667	285,284	327,000	612,284
Whitefish, Menominee	150,299	(1)	[1] 150,299	276,186	33,177	(1)	[1] 33,177
Yellow perch	280,638	83,400	364,038	1,151,398	12,226	100	12,326
Yellow pike	898,955	374,300	1,273,255	51,713	32,920	108,700	141,620
Miscellaneous	2,400	691,300	693,700	772,203	157,401	65,700	223,101
Total	9,943,228	7,884,900	17,828,128	17,998,657	13,132,435	5,400,400	18,532,835

Species	Namakan Lake			Rainy Lake		
	United States	Canada	Total	United States	Canada	Total
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Chubs	132,484	9,212	141,696	49,474	143,988	193,462
Lake trout	-----	-----	-----	-----	91	91
Pike (jacks)	103,765	5,778	109,543	67,681	207,818	275,499
Sturgeon	-----	426	426	517	1,667	2,184
Sucker, "mullet"	3,917	(1)	[1] 3,917	10,246	(1)	[1] 10,246
Whitefish, common	6,264	10,252	16,516	34,918	25,583	60,501
Yellow perch	2,158	-----	2,158	6,936	18,923	25,859
Yellow pike	18,223	12,686	30,909	51,542	167,032	218,574
Miscellaneous	-----	-----	-----	-----	8,966	8,966
Total	266,811	38,354	305,165	221,314	574,068	795,382

Species	Lake of the Woods			Total all lakes		
	United States	Canada	Total	United States	Canada	Total
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Blue pike	-----	26,011	26,011	4,842,520	2,144,811	6,987,331
Burbot	76,423	(1)	[1] 76,423	583,671	(1)	[1] 583,671
Carp	8,210	2,938	11,148	1,241,684	396,038	1,637,722
Catfish and bullheads	22,607	129,114	151,721	502,939	300,714	803,653
Chubs	28,229	-----	28,229	5,031,235	800,600	5,831,835
Cisco	-----	-----	-----	618,028	1,273,300	1,891,328
Lake herring	-----	-----	-----	14,937,679	4,015,500	18,953,179
Lake trout	198	14,003	14,201	9,417,844	6,415,194	15,833,038
Pike (jacks)	220,472	488,672	709,144	531,025	964,368	1,495,393
Sauger pike	37,637	(1)	[1] 37,637	1,595,821	(1)	[1] 1,595,821
Sheepshead	-----	-----	-----	2,933,937	(1)	[1] 2,933,937
Sturgeon	386	704	1,090	39,799	337,097	366,896
Sucker, "mullet"	117,167	(1)	[1] 117,167	3,994,667	(1)	[1] 3,994,667
Tullibees	219,954	46,037	265,991	219,954	46,037	265,991
White bass	-----	-----	-----	285,792	(1)	[1] 285,792
Whitefish, common	20,057	180,552	200,609	6,431,253	4,392,187	10,823,440
Whitefish, Menominee	-----	-----	-----	459,662	(1)	[1] 459,662
Yellow perch	11,995	1,720	13,715	5,784,017	4,597,943	10,381,960
Yellow pike	544,012	531,199	1,075,211	2,925,625	1,409,317	4,334,942
Miscellaneous	1,658	168,970	170,628	1,001,315	2,452,336	3,453,651
Total	1,309,005	1,589,920	2,898,925	63,368,467	29,545,442	92,913,909

[1] The Canadian catch of these species has been included under "Miscellaneous."

UNITED STATES

OPERATING UNITS

In conducting the survey of the operating units employed in the lake fisheries for 1928 an effort was made to determine the actual number of men, boats, and amount of gear employed in the fisheries. In making this determination only the average number of units of gear actually fishing simultaneously were counted, and those units being dried on shore, carried on the boats, or held in reserve were disregarded.

Fishermen.—There were 5,438 fishermen employed in the lake fisheries during 1928. Of this number, 72 per cent were engaged in the boat and shore fisheries and 28 per cent in the vessel fisheries. Thirty-two per cent was fished on Lake Michigan, 25 per cent on Lake Erie, 18 per cent on Lake Superior, 16 per cent on Lake Huron, 5 per cent on Lake Ontario, and 2 per cent on Lake of the Woods, Rainy Lake, and Namakan Lake.

Vessels.—During 1928 there were 134 steam vessels and 246 motor vessels engaged in the lake fisheries of the United States. Of this number 43 per cent of the steam vessels and 63 per cent of the motor vessels were engaged in fishing on Lake Michigan, 36 per cent of the steam vessels and 15 per cent of the motor vessels on Lake Erie, 11 per cent of the steam vessels and 12 per cent of the motor vessels on Lake Huron, 10 per cent of the steam vessels and 9 per cent of the motor vessels on Lake Superior, only 2 motor vessels were operated on Lake Ontario, and only 1 motor vessel on Lake of the Woods.

Boats.—There were 1,475 motor boats and 928 rowboats employed in the lake fisheries during 1928. Of this number 21 per cent of the motor boats and 18 per cent of the rowboats were engaged on Lake Michigan, 27 per cent of the motor boats and 18 per cent of the rowboats on Lake Erie, 21 per cent of the motor boats and 7 per cent of the rowboats on Lake Huron, 18 per cent of the motor boats and 49 per cent of the rowboats on Lake Superior, 8 per cent of the motor boats and 9 per cent of the rowboats on Lake Ontario, and 5 per cent of the motor boats and less than one-half of 1 per cent of the rowboats on Lake of the Woods, Rainy Lake, and Namakan Lake.

Gill nets.—During 1928 an average number of 99,348 gill nets were used in the lake fisheries. These nets had a total area, as fished, of 24,185,861 square yards, or more than 8 square miles. Of this amount 51 per cent were fished on Lake Michigan, 25 per cent on Lake Erie, 15 per cent on Lake Superior, 8 per cent on Lake Huron, 1 per cent on Lake Ontario, and less than one-half of 1 per cent on Lake of the Woods, Rainy Lake, and Namakan Lake.

Pound nets.—There were 1,722 pound nets used in the lake fisheries during 1928. Of this total 51 per cent were used on Lake Huron, 31 per cent on Lake Michigan, 10 per cent on Lake Superior, 4 per cent on Lake Erie, and 4 per cent on Lake of the Woods, Rainy Lake, and Namakan Lake.

Trap nets.—There were 6,221 trap nets fished during 1928. Of this number 69 per cent were fished on Lake Erie, 22 per cent on Lake Huron, 5 per cent on Lake Ontario, 4 per cent on Lake Michigan, and less than one-half of 1 per cent on Lake Superior.

Fyke nets.—There were 2,455 fyke nets fished during 1928. Of this number 48 per cent were fished on Lake Erie, 33 per cent on

Lake Michigan, 11 per cent on Lake Huron, 4 per cent on Lake Ontario, 3 per cent on Lake of the Woods, Rainy Lake, and Namakan Lake, and 1 per cent on Lake Superior.

Hooks.—There were 631,637 hooks fished on the Great Lakes during 1928. This includes 75 trolling hooks used on Lake Superior. Fifty-two per cent of the total number of hooks were fished on Lake Michigan, 32 per cent on Lake Superior, 10 per cent on Lake Huron, 3 per cent on Lake Erie, and 3 per cent on Lake Ontario.

Seines.—During 1928 there were 238 seines used in the lake fisheries. These had an aggregate length of 125,324 yards, and a combined area of 311,813 square yards. Of the total number 64 per cent were fished on Lake Erie, 21 per cent on Lake Huron, 11 per cent on Lake Michigan, 3 per cent on Lake Ontario, and 1 per cent on Lake Superior.

CATCH

Michigan, with frontage on Lakes Erie, Huron, Michigan, and Superior, ranked first in importance in the lake fisheries of the United States in 1928. The catch in the waters of this State amounted to 21,367,934 pounds, valued at $2,549,251. This is 34 per cent of the total catch of the Lakes, production in the United States, and 43 per cent of the total value. Ohio, with fisheries only on Lake Erie, ranked second with a catch of 15,890,016 pounds, valued at $1,134,770. This is 25 per cent of the total catch and 19 per cent of the total value. Wisconsin, with fisheries on Lakes Michigan and Superior, ranked third with a catch of 11,001,112 pounds, valued at $1,168,816. This represents 17 per cent of the total catch and 20 per cent of the total value. Minnesota was fourth, with a catch of 9,977,150 pounds, valued at $445,229. Minnesota had fisheries on Lake Superior, Lake of the Woods, Rainy Lake, and Namakan Lake, and its catch in these waters amounted to 16 per cent of the total quantity, and 8 per cent of the total value. The catch of fish in Pennsylvania, taken exclusively in Lake Erie, amounted to 1,957,820 pounds, valued at $253,422. This is 3 per cent of the total catch and 4 per cent of the total value. The catch of New York, which was taken from Lakes Ontario and Erie, amounted to 1,902,215 pounds and valued at $251,129. This is 3 per cent of the total catch and 4 per cent of the total value. The catch in Indiana amounted to 694,453 pounds, valued at $79,771. This is 1 per cent of the total catch, and 1 per cent of the total value. The catch in Illinois amounted to 577,767 pounds, valued at $78,396. This represents 1 per cent of the total catch, and 1 per cent of the total value.

Lake fisheries of the United States, 1928

OPERATING UNITS: BY STATES

Items	New York	Pennsylvania	Ohio	Michigan	Indiana
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	97	172	200	682	26
On boats and shore	317	37	756	1,555	27
Total	414	209	956	2,237	53
Vessels:					
Steam	6	21	22	59	3
Net tonnage	163	448	566	1,092	69
Motor	15	11	13	130	3
Net tonnage	102	122	185	1,116	33
Motor boats	126	12	339	665	11
Other boats	115	3	100	232	8

Lake fisheries of the United States, 1928—Continued

OPERATING UNITS: BY STATES—Continued

Items	New York	Pennsylvania	Ohio	Michigan	Indiana
Apparatus:	*Number*	*Number*	*Number*	*Number*	*Number*
Gill nets	6,206	10,509	9,201	39,763	1,349
Square yards	1,413,234	2,092,667	1,202,265	10,447,486	361,514
Pound nets		54	23	1,340	8
Trap nets	309	28	4,133	1,750	
Fyke nets	100		873	628	
Hooks	29,510		2,300	381,970	7,200
Trolling hooks				75	
Seines	6		128	77	
Length, yards	368		80,995	33,216	
Square yards	1,204		197,755	84,460	

Items	Illinois	Wisconsin	Minnesota	Total
Fishermen:	*Number*	*Number*	*Number*	*Number*
On vessels	32	320	2	1,531
On boats and shore	24	624	567	3,907
Total	56	944	569	5,438
Vessels:				
Steam	1	22		134
Net tonnage	14	601		2,953
Motor	7	66	1	246
Net tonnage	80	966	7	2,611
Motor boats	9	177	136	1,475
Other boats	4	79	387	928
Apparatus:				
Gill nets	1,994	24,087	6,239	99,348
Square yards	434,728	6,160,411	2,073,556	24,185,861
Pound nets	1	221	75	1,722
Trap nets		1		6,221
Fyke nets	302	468	84	2,455
Hooks		210,342	240	631,562
Trolling hooks				75
Seines		27		238
Length, yards		10,745		125,324
Square yards		28,394		311,813

OPERATING UNITS: BY LAKES

Items	Lake Ontario	Lake Erie	Lake Huron	Lake Michigan	Lake Superior	Lake of the Woods, Rainy Lake, and Namakan Lake	Total
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	6	463	187	730	143	2	1,531
On boats and shore	247	965	708	1,039	844	104	3,907
Total	253	1,428	895	1,769	987	106	5,438
Vessels:							
Steam		49	15	57	13		134
Net tonnage		1,177	340	1,126	310		2,953
Motor	2	37	30	155	21	1	246
Net tonnage	10	399	275	1,728	192	7	2,611
Motor boats	110	394	312	312	270	77	1,475
Other boats	79	162	69	165	450	3	928
Apparatus:							
Gill nets	1,074	24,842	8,280	50,132	14,747	273	99,348
Square yards	262,615	4,445,551	2,750,127	12,053,884	4,594,518	79,166	24,185,861
Pound nets		77	871	524	175	75	1,722
Trap nets	299	4,311	1,362	225	24		6,221
Fyke nets	100	1,179	259	810	23	84	2,455
Hooks	16,100	15,910	66,950	329,915	202,687		631,562
Trolling hooks					75		75
Seines	6	154	49	27	2		238
Length, yards	368	93,416	19,963	10,745	832		125,324
Square yards	1,204	230,777	49,658	28,394	1,780		311,813

Lake fisheries of the United States, 1928—Continued

OPERATING UNITS: BY STATES AND LAKES

Items	New York			Pennsylvania, Lake Erie	Ohio, Lake Erie
	Lake Ontario	Lake Erie	Total		
ishermen:	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	6	91	97	172	200
On boats and shore	247	70	317	37	756
Total	253	161	414	209	956
Vessels:					
Steam	-----	6	6	21	22
Net tons	-----	163	163	448	566
Motor	2	13	15	11	13
Net tons	10	92	102	122	185
Total vessels	2	19	21	32	35
Total net tonnage	10	255	265	570	751
Boats:					
Motor	110	16	126	12	339
Other	79	36	115	3	100
"Shoal" gill nets, 3-3 1/16 inches: [1]					
Fished by vessels	20	1,707	1,727	6,904	7,858
Square yards	1,778	232,497	234,275	1,099,558	873,004
Fished by boats	393	200	593	117	205
Square yards	72,944	26,945	99,889	17,094	20,327
Total	413	1,907	2,320	7,021	8,063
Square yards	74,722	259,442	334,164	1,116,652	893,331
"Shoal" gill nets, 4½-6 inches: [2]					
Fished by vessels	110	2,056	2,166	696	80
Square yards	20,889	488,002	508,891	92,800	19,200
Fished by boats	495	48	543	-----	-----
Square yards	109,958	7,680	117,638	-----	-----
Total	605	2,104	2,709	696	80
Square yards	130,847	495,682	626,529	92,800	19,200
"Bull" gill nets, 3-3 1/16 inches: [1]					
Fished by vessels	-----	728	728	1,944	868
Square yards	-----	303,445	303,445	687,215	255,289
Fished by boats	-----	32	32	-----	-----
Square yards	-----	12,288	12,288	-----	-----
Total	-----	760	760	1,944	868
Square yards	-----	315,733	315,733	687,215	255,289
"Bull" gill nets, 4½-5½ inches: [2]					
Fished by vessels	-----	232	232	848	98
Square yards	-----	51,555	51,555	196,000	27,111
Fished by boats	-----	48	48	-----	-----
Square yards	-----	10,240	10,240	-----	-----
Total	-----	280	280	848	98
Square yards	-----	61,795	61,795	196,000	27,111
Sturgeon gill nets, 10-12 inches: [3]					
Fished by boats	56	81	137	-----	-----
Square yards	57,046	17,967	750,013	-----	-----
Bar gill nets, 5 inches: [4]					
Fished by boats	-----	-----	-----	-----	92
Square yards	-----	-----	-----	-----	7,334
Pound nets, fished by boats [5]	-----	-----	-----	54	23

[1] 3-inch mesh is permitted by New York only, on both Lake Erie and Lake Ontario for both shoal and bull nets and can take any species except whitefish, lake trout, and sturgeon. Pennsylvania and Ohio prescribe a 3 1/16-inch mesh for both shoal and bull nets.

[2] Used principally for taking whitefish, trout, and suckers. No 4½-inch is permitted on Lakes Ontario and Erie, except in the State of Michigan, where none are used.

[3] Used principally for taking sturgeon.

[4] Used principally for taking carp.

[5] Used for taking miscellaneous fish

Lake fisheries of the United States, 1928—Continued

OPERATING UNITS: BY STATES AND LAKES—Continued

Items	New York			Pennsylvania, Lake Erie	Ohio, Lake Erie
	Lake Ontario	Lake Erie	Total		
	Number	*Number*	*Number*	*Number*	*Number*
Trap nets: [5]					
Fished by vessels	1		1		70
Fished by boats	298	10	308	28	4,063
Total	299	10	309	28	4,133
Fyke nets: [5]					
Fished by vessels					200
Fished by boats	100		100		673
Total	100		100		873
Hooks, fished by boats [6]					2,300
Sturgeon hooks, fished by boats [7]	16,100	13,410	29,510		
Seines, fished by boats [8]	6		6		128
Length, yards	368		368		80,995
Square yards	1,204		1,204		197,755

Items	Michigan					Indiana, Lake Michigan
	Lake Erie	Lake Huron	Lake Michigan	Lake Superior	Total	
	Number	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:						
On vessels		187	372	123	682	26
On boats and shore	102	708	479	266	1,555	27
Total	102	895	851	389	2,237	53
Vessels:						
Steam		15	32	12	59	3
Net tons		340	475	277	1,092	69
Motor		30	83	17	130	3
Net tons		275	713	128	1,116	33
Total vessels		45	115	29	189	6
Total net tonnage		615	1,188	405	2,208	102
Boats:						
Motor	27	312	165	161	665	11
Other	23	69	103	37	232	8
Gill nets, 2⅛–2⅞ inches: [9]						
Fished by vessels		1,728	4,301	210	6,239	587
Square yards		580,110	978,085	47,312	1,605,507	149,980
Fished by boats		466	2,183	332	2,981	168
Square yards		88,053	243,453	94,096	425,602	29,167
Total		2,194	6,484	542	9,220	755
Square yards		668,163	1,221,538	141,408	2,031,109	179,147

[5] Used for taking miscellaneous fish.
[6] Used principally for taking catfish.
[7] Used principally for taking sturgeon.
[8] Used principally for taking carp, catfish, bullheads, and burbot.
[9] Used principally for taking chubs, herring, perch, bluefin, and Menominees. Michigan prescribes 2¾-inch to 2⅞-inch, and Indiana 2½-inch to 2⅞-inch for chubs and herring. Indiana prescribes 2⅜-inch, while Michigan prescribes 2¾-inch to 2⅞-inch, except that 2½-inch may be used from November 1 to December 17 under certain restrictions as to depth, and 2¼-inch from January 1 to April 1 under the ice when bottom of net is not less than 20 feet from bottom of lake or bay. Two and three-quarters inch mesh is permitted by Wisconsin in Green Bay and in Lake Superior. In Green Bay 2⅛-inch mesh may be used for herring, chubs, perch, and other rough fish from December 1 until the ice goes out, and is to be fished under and hung to ice. In Lake Michigan, Wisconsin prescribes 2⅝-inch for minimum mesh. In Minnesota 2⅜-inch may be used for herring but 2⅝-inch for chubs.

Lake fisheries of the United States, 1928—Continued

OPERATING UNITS: BY STATES AND LAKES—Continued

Items	Michigan					Indiana, Lake Michigan
	Lake Erie	Lake Huron	Lake Michigan	Lake Superior	Total	
Gill nets, 4-6 inches:[10]	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fished by vessels		3,844	13,924	3,127	20,895	552
Square yards		1,436,463	3,595,418	1,060,650	6,092,531	171,867
Fished by boats		2,242	4,752	2,654	9,648	42
Square yards		645,501	966,924	711,421	2,323,846	10,500
Total		6,086	18,676	5,781	30,543	594
Square yards		2,081,964	4,562,342	1,772,071	8,416,377	182,367
Pound nets:[5]						
Fished by vessels		39	71	38	148	
Fished by boats		832	279	81	1,192	8
Total		871	350	119	1,340	8
Trap nets:[5]						
Fished by vessels		187	134	6	327	
Fished by boats	140	1,175	91	17	1,423	
Total	140	1,362	225	23	1,750	
Fyke nets:[5]						
Fished by vessels		10			10	
Fished by boats	306	249	61	2	618	
Total	306	259	61	2	628	
Hooks:[11]						
Fished by vessels		48,150	112,200	99,100	259,450	7,200
Fished by boats	200	18,800	10,840	92,680	122,520	
Total	200	66,950	123,040	191,780	381,970	7,200
Trolling hooks, fished by boats[11]				75	75	
Seines, fished by boats[12]	26	49		2	77	
Length, yards	12,421	19,963		832	33,216	
Square yards	33,022	49,658		1,780	84,460	

Items	Illinois, Lake Michigan	Wisconsin			Minnesota		
		Lake Michigan	Lake Superior	Total	Lake Superior	Lake of the Woods, Rainy Lake, and Namakan Lake	Total
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	32	300	20	320		2	2
On boats and shore	24	509	115	624	463	104	567
Total	56	809	135	944	463	106	569
Vessels:							
Steam	1	21	1	22			
Net tons	14	568	33	601			
Motor	7	62	4	66		1	1
Net tons	80	902	64	966		7	7
Total vessels	8	83	5	88		1	1
Total net tonnage	94	1,470	97	1,567		7	7

[5] Used for taking miscellaneous fish.
[10] Used principally for taking whitefish, trout, pike, and suckers. Both Michigan and Indiana prescribe 4½-inch mesh for whitefish and trout. Wisconsin is the only State that permits 4-inch mesh for these species.
[11] Used principally for taking trout.
[12] Used principally for taking carp, pike, perch, and suckers.

Lake fisheries of the United States, 1928—Continued

OPERATING UNITS: BY STATES AND LAKES—Continued

Items	Illinois, Lake Michigan	Wisconsin			Minnesota		
		Lake Michigan	Lake Superior	Total	Lake Superior	Lake of the Woods, Rainy Lake, and Namakan Lake	Total
Boats:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Motor	9	127	50	177	59	77	136
Other	4	50	29	79	384	3	387
Gill nets, $2\frac{1}{8}$–$2\frac{7}{8}$ inches: [9]							
Fished by vessels	618	6,010	152	6,162			
Square yards	120,225	1,859,601	50,867	1,910,468			
Fished by boats	441	5,076	419	5,495	4,622		4,622
Square yards	68,349	708,769	94,872	803,641	1,491,286		1,491,286
Total	1,059	11,086	571	11,657	4,622		4,622
Square yards	188,574	2,568,370	145,739	2,714,109	1,491,286		1,491,286
Gill nets, 4-6 inches: [10]							
Fished by vessels	723	5,083	158	5,241		4	4
Square yards	204,848	2,182,402	53,400	2,235,802		1,334	1,334
Fished by boats	212	5,460	1,729	7,189	1,344	269	1,613
Square yards	41,306	722,990	487,510	1,210,500	503,104	77,832	580,936
Total	935	10,543	1,887	12,430	1,344	273	1,617
Square yards	246,154	2,905,392	540,910	3,446,302	503,104	79,166	582,270
Pound nets: [5]							
Fished by vessels		4		4			
Fished by boats	1	161	56	217		75	75
Total	1	165	56	221		75	75
Trap nets: [5]							
Fished by boats			1	1			
Fyke nets: [5]							
Fished by vessels	105	55	4	59			
Fished by boats	197	392	17	409		84	84
Total	302	447	21	468		84	84
Hooks: [11]							
Fished by vessels		147,975		147,975			
Fished by boats		51,700	10,667	62,367	240		240
Total		199,675	10,667	210,342	240		240
Seines, fished by boats [12]		27		27			
Length, yards		10,745		10,745			
Square yards		28,394		28,394			

[5] Used for taking miscellaneous fish.

[9] Used principally for taking chubs, herring, perch, bluefin, and Menominees. Michigan prescribes $2\frac{3}{4}$-inch to $2\frac{7}{8}$-inch, and Indiana $2\frac{1}{2}$-inch to $2\frac{7}{8}$-inch for chubs and herring. Indiana prescribes $2\frac{3}{8}$-inch, while Michigan prescribes $2\frac{3}{4}$-inch to $2\frac{7}{8}$-inch, except that $2\frac{1}{2}$-inch may be used from November 1 to December 17 under certain restrictions as to depth, and $2\frac{1}{4}$-inch from January 1 to April 1 under the ice when bottom of net is not less than 20 feet from bottom of lake or bay. Two and three-quarters inch mesh is permitted by Wisconsin in Green Bay and in Lake Superior. In Green Bay $2\frac{1}{8}$-inch mesh may be used for herring, chubs, perch, and other rough fish from December 1 until the ice goes out, and is to be fished under and hung to ice. In Lake Michigan, Wisconsin prescribes $2\frac{5}{8}$-inch for minimum mesh. In Minnesota $2\frac{3}{8}$-inch may be used for herring but $2\frac{5}{8}$-inch for chubs.

[10] Used principally for taking whitefish, trout, pike, and suckers. Both Michigan and Indiana prescribe $4\frac{1}{2}$-inch mesh for whitefish and trout. Wisconsin is the only State that permits 4-inch mesh for these species.

[11] Used principally for taking trout.

[12] Used principally for taking carp, pike, perch, and suckers.

Lake fisheries of the United States, 1928—Continued

OPERATING UNITS OF LAKE ONTARIO: BY GEAR

Items	Gill nets	Trap nets	Fyke nets	Sturgeon hooks	Seines	Total, exclusive of duplication
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	6	2				6
On boats and shore	99	100	16	42	14	247
Total	105	102	16	42	14	253
Vessels, motor, 5 to 10 tons	2	1				2
Net tonnage	10	5				10
Boats:						
Motor	51	48	7	14	2	110
Other	16	31	8	25	5	79
Apparatus:						
Number	1,074	299	100	16,100	6	
Lengths, yards					368	
Square yards	262,615				1,204	

OPERATING UNITS OF LAKE ERIE: BY GEAR

Items	Gill nets	Pound nets	Trap nets	Fyke nets	Hooks	Seines	Total, exclusive of duplication
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	451		12	12			463
On boats and shore	62	31	463	84	57	332	965
Total	513	31	475	96	57	332	1,428
Vessels:							
Steam—							
5 to 10 tons	2						2
11 to 20 tons	12						12
21 to 30 tons	21		1	1			22
31 to 40 tons	12						12
61 to 70 tons	1						1
Total	48		1	1			49
Net tonnage	1,155		22	22			1,177
Motor—							
5 to 10 tons	27						27
11 to 20 tons	6						6
21 to 30 tons	2						2
31 to 40 tons	2						2
Total	37						37
Net tonnage	399						399
Total vessels	85		1	1			86
Total net tonnage	1,554		22	22			1,576
Boats:							
Motor	24	11	231	39	2	116	394
Other	9		10	26	53	75	162
Apparatus:							
Number	24,842	77	4,311	1,179	15,910	154	
Length, yards						93,416	
Square yards	4,445,551					230,777	

Lake fisheries of the United States, 1928—Continued

OPERATING UNITS OF LAKE HURON: BY GEAR

Items	Gill nets	Pound nets	Trap nets	Fyke nets	Hooks	Seines	Total, exclusive of duplication
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	157	23	34	4	43		187
On boats and shore	216	314	186	35	15	119	708
Total	373	337	220	39	58	119	895
Vessels:							
Steam—							
5 to 10 tons	1	1	1		1		2
11 to 20 tons	5	2	1		1		6
21 to 30 tons	3				2		3
31 to 40 tons	3				1		3
51 to 60 tons	1						1
Total	13	3	2		5		15
Net tonnage	320	32	20		105		340
Motor—							
5 to 10 tons	17	5	6	1	2		22
11 to 20 tons	6		2		1		8
Total	23	5	8	1	3		30
Net tonnage	207	37	79	8	32		275
Total vessels	36	8	10	1	8		45
Total net tonnage	527	69	99	8	137		615
Boats:							
Motor	100	142	83	19	9	39	312
Other	27	15	7	5		20	69
Apparatus:							
Number	8,280	871	1,362	259	66,950	49	
Length, yards						19,963	
Square yards	2,750,127					49,658	

OPERATING UNITS OF LAKE MICHIGAN: BY GEAR

Items	Gill nets	Pound nets	Trap nets	Fyke nets	Hooks	Seines	Total, exclusive of duplication
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	685	65	14	25	199		730
On boats and shore	788	306	37	116	54	60	1,039
Total	1,473	371	51	141	253	60	1,769
Vessels:							
Steam—							
5 to 10 tons	9				2		9
11 to 20 tons	24	1			8		25
21 to 30 tons	11				4		13
31 to 40 tons	6				5		7
41 to 50 tons	1				1		2
51 to 60 tons	1						1
Total	52	1			20		57
Net tonnage	983	15			469		1,126
Motor—							
5 to 10 tons	96	20	6	8	21		102
11 to 20 tons	34	2	1	1	10		36
21 to 30 tons	11				2		11
31 to 40 tons	5				1		5
41 to 50 tons	1						1
Total	147	22	7	9	34		155
Net tonnage	1,659	164	52	76	366		1,728
Total vessels	199	23	7	9	54		212
Total net tonnage	2,642	179	52	76	835		2,854
Boats:							
Motor	236	119	12	47	19	9	312
Other	119	31	9	21	7	16	165
Apparatus:							
Number	50,132	524	225	810	329,915	27	
Length, yards						10,745	
Square yards	12,053,884					28,394	

Lake fisheries of the United States, 1928—Continued

OPERATING UNITS OF LAKE SUPERIOR: BY GEAR

Items	Gill nets	Pound nets	Trap nets	Fyke nets	Hooks	Trolling hooks	Seines	Total, exclusive of duplication
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
On vessels	137	16	3	2	78			143
On boats and shore	780	61	8	13	136	14	4	844
Total	917	77	11	15	214	14	4	987
Vessels:								
Steam—								
5 to 10 tons	2	1			3			3
11 to 20 tons	3				2			3
21 to 30 tons	3				2			3
31 to 40 tons	2				1			2
41 to 50 tons	1							1
51 to 60 tons	1							1
Total	12	1			8			13
Net tonnage	303	10			138			310
Motor—								
5 to 10 tons	17	4	1	1	9			18
11 to 20 tons	1				1			1
21 to 30 tons	2							2
Total	20	4	1	1	10			21
Net tonnage	186	32	9	6	74			192
Total vessels	32	5	1	1	18			34
Total net tonnage	489	42	9	6	212			502
Boats:								
Motor	226	31	2	6	83	10		270
Other	439	13	5	4	4		2	450
Apparatus:								
Number	14,747	175	24	23	202,687	75	2	
Length, yards							832	
Square yards	4,594,518						1,780	

OPERATING UNITS OF LAKE OF THE WOODS, RAINY LAKE, AND NAMAKAN LAKE: BY GEAR

Items	Gill nets	Pound nets	Fyke nets	Total, exclusive of duplication
Fishermen:	*Number*	*Number*	*Number*	*Number*
On vessels	2			2
On boats and shore	86	42	24	104
Total	88	42	24	106
Vessels:				
Motor	1			1
Net tonnage	7			7
Boats:				
Motor	73	28	23	77
Other	3	1	1	3
Apparatus:				
Number	273	75	84	
Square yards	79,166			

Lake fisheries of the United States, 1928—Continued

CATCH: BY STATES

Species	New York		Pennsylvania		Ohio		Michigan	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Blue pike	472, 500	$55, 779	627, 283	$69, 715	3, 742, 737	$299, 419		
Burbot	70, 569	4, 621	4, 194	65	400, 191	8, 003	14, 510	$290
Carp	19, 555	1, 422	7, 969	425	341, 106	17, 055	864, 844	40, 359
Catfish and bullheads	41, 014	7, 915	5, 914	787	228, 293	19, 933	205, 111	17, 818
Chubs							1, 371, 461	104, 364
Cisco	238, 446	32, 733	356, 070	45, 162	23, 508	2, 986	4	1
Lake herring	342, 187	35, 428					3, 976, 915	170, 594
Lake trout	45, 951	7, 014	73	16			5, 702, 174	903, 632
Pike (jacks)							33, 809	3, 074
Sauger pike					1, 491, 867	122, 333	66, 317	7, 469
Sheepshead			33, 229	1, 994	2, 854, 640	77, 075	46, 068	1, 986
Sturgeon	26, 411	12, 755	762	381	35	14	1, 688	675
Sucker "mullet"	107, 049	8, 506	30, 200	1, 169	1, 208, 119	56, 782	2, 515, 999	121, 921
White bass	352	35	29, 653	1, 483	255, 174	17, 862	613	31
Whitefish, common	271, 711	59, 636	402, 168	101, 011	415, 458	83, 092	4, 653, 475	919, 305
Whitefish, Menominee							436, 832	51, 885
Yellow perch	175, 168	13, 491	447, 140	28, 603	3, 678, 046	246, 429	472, 170	45, 540
Yellow pike	29, 440	6, 940	13, 034	2, 598	1, 245, 267	183, 676	990, 347	159, 113
Miscellaneous	61, 862	4, 854	131	13	5, 575	111	15, 597	1, 194
Total	1,902,215	251, 129	1,957,820	253, 422	15,890,016	1,134,770	21,367,934	2,549,251

Species	Indiana		Illinois		Wisconsin		Minnesota		Total	
	Lbs.	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*
Blue pike									4, 842, 520	$424, 913
Burbot	17, 784	$1, 277					76, 423	$1, 012	583, 671	15, 268
Carp							8, 210	493	1, 241, 684	59, 754
Catfish and bullheads							22, 607	2, 261	502, 939	48, 714
Chubs	104, 237	12, 841	276, 795	$33, 215	2, 754, 952	$318, 469	523, 790	28, 790	5, 031, 235	497, 679
Cisco									618, 028	80, 882
Lake herring	300, 917	16, 875	101, 760	6, 106	2, 764, 316	91, 954	7, 451, 584	221, 346	14, 937, 679	542, 303
Lake trout	186, 608	37, 689	171, 612	36, 039	2, 920, 651	533, 597	390, 775	50, 435	9, 417, 844	1, 568, 422
Pike (jacks)					105, 298	5, 866	391, 918	19, 211	531, 025	28, 151
Sauger pike							37, 637	2, 675	1, 595, 821	132, 477
Sheepshead									2, 933, 937	81, 055
Sturgeon							903	356	29, 799	14, 181
Sucker "mullet"	720	72					132, 580	2, 662	3, 994, 667	191, 112
Tullibees							219, 954	11, 197	219, 954	11, 197
White bass									285, 792	19, 411
Whitefish, common	15, 454	3, 328			608, 552	106, 247	64, 435	9, 029	6, 431, 253	1, 281, 648
Whitefish, Menominee					3, 020	453	19, 810	1, 451	459, 662	53, 789
Yellow perch	60, 733	6, 089	27, 600	3, 036	902, 071	58, 397	21, 089	2, 310	5, 784, 017	403, 895
Yellow pike					33, 760	5, 781	613, 777	91, 819	2, 925, 625	449, 927
Miscellaneous	8, 000	1, 600			908, 492	48, 052	1, 658	182	1, 001, 315	56, 006
Total	694, 453	79, 771	577, 767	78, 396	11, 001, 112	1, 168, 816	9, 977, 150	445, 229	63, 368, 467	5, 960, 784

CATCH: BY LAKES

Species	Lake Ontario		Lake Erie			
	New York		New York		Pennsylvania	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Blue pike	23, 728	$2, 906	448, 772	$52, 873	627, 283	$69, 715
Burbot	64, 232	4, 241	6, 337	380	4, 194	65
Carp	18, 365	1, 307	1, 190	115	7, 969	425
Catfish and bullheads	40, 729	7, 884	285	31	5, 914	787
Cisco			238, 446	32, 733	356, 070	45, 162
Lake herring	342, 187	35, 428				
Lake trout	43, 223	6, 644	2, 728	370	73	16
Sheepshead					33, 229	1, 994
Sturgeon	19, 595	9, 482	6, 816	3, 273	762	381
Sucker "mullet"	70, 815	6, 134	36, 234	2, 372	30, 200	1, 169
White bass			352	35	29, 653	1, 483
Whitefish, common	115, 793	20, 896	155, 918	38, 740	402, 168	101, 011
Yellow perch	44, 679	3, 803	130, 489	9, 688	447, 140	28, 603
Yellow pike	19, 840	4, 831	9, 600	2, 109	13, 034	2, 598
Miscellaneous	50, 661	4, 371	11, 201	483	131	13
Total	853, 847	107, 927	1, 048, 368	143, 202	1, 957, 820	253, 422

Lake fisheries of the United States, 1928—Continued

CATCH: BY LAKES—Continued

Species	Lake Erie					
	Ohio		Michigan		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Blue pike	3,742,737	$299,419			4,818,792	$422,007
Burbot	400,191	8,003			410,722	8,448
Carp	341,106	17,055	568,385	$28,419	918,650	46,014
Catfish and bullheads	228,293	19,933	32,222	2,256	266,714	23,007
Cisco	23,508	2,986	4	1	618,028	80,882
Lake trout					2,801	386
Pike (jacks)			647	45	647	45
Sauger pike	1,491,867	122,333	10,458	837	1,502,325	123,170
Sheepshead	2,854,640	77,075	31,724	1,269	2,919,593	80,338
Sturgeon	35	14			7,613	3,668
Sucker "mullet"	1,208,119	56,782	43,685	2,184	1,318,238	62,507
White bass	255,174	17,862			285,179	19,380
Whitefish, common	415,458	83,092	925	176	974,469	223,019
Yellow perch	3,678,046	246,429	18,312	1,227	4,273,987	285,947
Yellow pike	1,245,267	183,676	40,519	6,078	1,308,420	194,461
Miscellaneous	5,575	111	85	2	16,992	609
Total	15,890,016	1,134,770	746,966	42,494	19,643,170	1,573,888

Species	Lake Huron		Lake Michigan			
	Michigan		Michigan		Indiana	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Burbot	2,088	$42	12,422	$248	17,784	$1,277
Carp	282,592	11,304	11,082	497		
Catfish and bullheads	171,042	15,394	1,634	147		
Chubs	427,250	34,180	646,798	51,744	104,237	12,841
Lake herring	2,709,041	121,907	532,535	26,627	300,917	16,875
Lake trout	1,597,851	255,656	1,831,127	329,729	186,608	37,689
Pike (jacks)	19,759	1,778	8,986	809		
Sauger pike	46,093	5,531	7,994	959		
Sheepshead	12,742	637	1,602	80		
Sturgeon	15	6	1,673	669		
Sucker "mullet"	1,873,049	93,652	455,629	22,781	720	72
White bass	613	31				
Whitefish, common	1,468,801	293,760	2,956,146	591,229	15,454	3,328
Whitefish, Menominee	150,299	18,036	273,166	32,780		
Yellow perch	280,638	28,064	162,414	14,617	60,733	6,089
Yellow pike	898,955	143,833	31,832	5,411		
Miscellaneous	2,400	143	6,485	519	8,000	1,600
Total	9,943,228	1,023,954	6,941,525	1,078,846	694,453	79,771

Species	Lake Michigan					
	Illinois		Wisconsin		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Burbot					30,206	$1,525
Carp					11,082	497
Catfish and bullheads					1,634	147
Chubs	276,795	$33,215	2,724,160	$316,669	3,751,990	414,469
Lake herring	101,760	6,106	2,097,546	77,814	3,032,758	127,422
Lake trout	171,612	36,039	2,629,376	492,099	4,818,723	895,556
Pike (jacks)			98,493	5,144	107,479	5,953
Sauger pike					7,994	959
Sheepshead					1,602	80
Sturgeon					1,673	669
Sucker "mullet"					456,349	22,853
Whitefish, common			554,067	98,665	3,525,667	693,222
Whitefish, Menominee			3,020	453	276,186	33,233
Yellow perch	27,600	3,036	900,651	58,184	1,151,398	81,926
Yellow pike			19,881	2,978	51,713	8,389
Miscellaneous			757,718	43,492	772,203	45,611
Total	577,767	78,396	9,784,912	1,095,498	17,998,657	2,332,511

Lake fisheries of the United States, 1928—Continued

CATCH: BY LAKES—Continued

Species	Lake Superior					
	Michigan		Wisconsin		Minnesota	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp	2,785	$139				
Catfish and bullheads	213	21				
Chubs	297,413	18,440	30,792	$1,800	313,603	$21,625
Lake herring	735,339	22,060	666,770	14,140	7,451,584	221,346
Lake trout	2,273,196	318,247	291,275	41,498	390,577	50,407
Pike (jacks)	4,417	442	6,805	722		
Sauger pike	1,772	142				
Sucker "mullet"	143,636	3,304			1,250	28
Whitefish, common	227,603	34,140	54,485	7,582	3,196	616
Whitefish, Menominee	13,367	1,069			19,810	1,451
Yellow perch	10,806	1,632	1,420	213		
Yellow pike	19,041	3,791	13,879	2,803		
Miscellaneous	6,627	530	150,774	4,560		
Total	3,736,215	403,957	1,216,200	73,318	8,180,020	295,473

Species	Lake Superior		Lake of the Woods, Rainy Lake, and Namakan Lake		Total, all lakes	
	Total		Minnesota			
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Blue pike					4,842,520	$424,913
Burbot			76,423	$1,012	583,671	15,268
Carp	2,785	$139	8,210	493	1,241,684	59,754
Catfish and bullheads	213	21	22,607	2,261	502,939	48,714
Chubs	641,808	41,865	210,187	7,165	5,031,235	497,679
Cisco					618,028	80,882
Lake herring	8,853,693	257,546			14,937,679	542,303
Lake trout	2,955,048	410,152	198	28	9,417,844	1,568,422
Pike (jacks)	11,222	1,164	391,918	19,211	531,025	28,151
Sauger pike	1,772	142	37,637	2,675	1,595,821	132,477
Sheepshead					2,933,937	81,055
Sturgeon			903	356	29,799	14,181
Sucker "mullet"	144,886	3,332	131,330	2,634	3,994,667	191,112
Tullibees			219,954	11,197	219,954	11,197
White bass					285,792	19,411
Whitefish, common	285,284	42,338	61,239	8,413	6,431,253	1,281,648
Whitefish, Menominee	33,177	2,520			459,662	53,789
Yellow perch	12,226	1,845	21,089	2,310	5,784,017	403,895
Yellow pike	32,920	6,594	613,777	91,819	2,925,625	449,927
Miscellaneous	157,401	5,090	1,658	182	1,001,315	56,006
Total	13,132,435	772,748	1,797,130	149,756	63,368,467	5,960,784

HISTORICAL REVIEW

Statistics of the catch in the United States waters of the Great Lakes are available for various years from 1885 to 1908, inclusive, and for all the years from 1913 to 1928, inclusive. During these periods the catch has been marked by many fluctuations, reaching a peak in 1890 when the catch amounted to 113,899,000 pounds and registered the smallest catch on record in 1928 when 63,368,000 pounds were taken.

Since 1913 records of the catch in the Canadian waters of the Great Lakes are available as well as those for the United States waters. During the 5-year period, from 1916 to 1920, inclusive, an average catch of 129,162,000 pounds was registered for the Lakes, while that in 1928 amounted to 92,914,000 pounds. Comparative statistics for each of the species taken in the United States and Canada since 1913 are shown in the following tables:

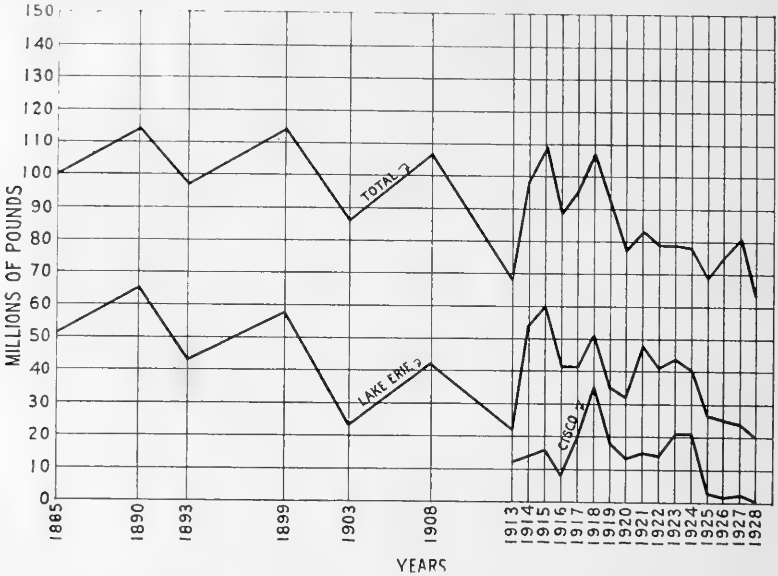

FIGURE 26.—Yield of the lake fisheries for various years, 1885 to 1928

Lake fisheries of the United States for certain years, 1885–1928

[Expressed in thousands of pounds; that is, 000 omitted]

Year	Lake Ontario [1]	Lake Erie	Lake St. Clair and St. Clair and Detroit Rivers	Lake Huron	Lake Michigan	Lake Superior	Lake of the Woods, Rainy Lake, and Namakan Lake [2]	Total
1885	2, 398	51, 457	2, 186	11, 457	23, 518	8, 826	(3)	99, 842
1890	3, 447	64, 851	2, 995	10, 056	26, 434	6, 116	(3)	113, 899
1893	928	42, 969	1, 814	12, 064	30, 748	8, 097	(3)	96, 620
1899	2, 406	58, 394	579	12, 418	34, 500	5, 430	(3)	113, 727
1903	1, 245	23, 189	522	14, 455	33, 579	13, 205	(3)	86, 195
1908	823	41, 922	737	12, 932	40, 019	10, 198	(3)	106, 631
1913	210	22, 120	(3)	11, 184	26, 994	6, 417	1, 384	68, 309
1914	277	53, 571	(3)	8, 248	28, 195	7, 088	1, 246	98, 625
1915	395	59, 509	(3)	10, 245	31, 680	5, 694	1, 425	108, 948
1916	317	41, 223	(3)	17, 145	23, 023	5, 437	1, 287	88, 432
1917	656	41, 416	(3)	12, 512	29, 317	9, 889	2, 103	95, 893
1918	524	51, 479	(3)	14, 966	26, 675	11, 546	1, 489	106, 679
1919	472	35, 154	(3)	15, 240	29, 820	10, 500	1, 277	92, 463
1920	314	32, 192	(3)	11, 250	23, 053	9, 267	1, 299	77, 375
1921	1, 855	46, 731	(3)	9, 330	17, 018	7, 476	1, 048	83, 458
1922	889	40, 912	(3)	13, 481	16, 605	6, 569	978	79, 434
1923	710	44, 378	(3)	9, 920	15, 358	7, 584	1, 159	79, 109
1924	1, 049	40, 264	(3)	9, 074	17, 694	8, 944	1, 256	78, 281
1925	446	26, 639	(3)	6, 567	21, 710	12, 307	1, 463	69, 132
1926	788	25, 057	(3)	13, 132	20, 495	13, 436	2, 392	75, 300
1927	698	23, 796	(3)	15, 711	23, 681	15, 302	2, 139	81, 327
1928	854	19, 643	(3)	9, 943	17, 999	13, 132	1, 797	63, 368

[1] Includes the catch in Lake Ontario proper and Chaumont Bay in the years from 1913 to 1924, inclusive; Lake Ontario proper in 1925, and Lake Ontario proper, Niagara River below the falls, St. Lawrence River and Chaumont, Black River, Port, Great Sodus and Little Sodus Bays, prior to 1913 and since 1925.
[2] Does not include the catch in Namakan and Rainy Lakes prior to 1926.
[3] Comparable data not available.

Lake fisheries of the United States and Canada, 1913 to 1928

CATCH: BY LAKES

[Expressed in thousands of pounds; that is, 000 omitted]

Years	Lake Ontario			Lake Erie			Lake Huron			Lake Michigan, United States
	United States [1]	Canada [2]	Total	United States	Canada	Total	United States	Canada	Total	
Average, 1913-1915	294	3,711	4,005	45,067	18,691	63,758	9,892	6,739	16,631	28,956
Average, 1916-1920	457	5,193	5,650	40,293	16,363	56,656	14,222	6,760	20,982	26,378
Average, 1921-1925	990	4,778	5,768	39,785	16,384	56,169	9,674	7,072	16,746	17,677
1926	788	4,227	5,015	25,057	8,752	33,809	13,132	7,483	20,615	20,495
1927	698	3,842	4,540	23,796	10,069	33,865	15,711	8,864	24,575	23,681
1928	854	3,591	4,445	19,643	10,467	30,110	9,943	7,885	17,828	17,999

Years	Lake Superior			Lake of the Woods, Rainy Lake, and Namakan Lake			Total		
	United States	Canada	Total	United States [3]	Canada [4]	Total	United States	Canada	Total
Average, 1913-1915	6,400	3,654	10,054	1,352	3,816	5,168	91,961	36,611	128,572
Average, 1916-1920	9,328	5,959	15,287	1,491	2,718	4,209	92,169	36,993	129,162
Average, 1921-1925	8,576	3,828	12,404	1,181	3,013	4,194	77,883	35,075	112,958
1926	13,436	4,311	17,747	2,392	2,725	5,117	75,300	27,498	102,798
1927	15,302	5,152	20,454	2,139	2,699	4,838	81,327	30,626	111,953
1928	13,132	5,401	18,533	1,797	2,202	3,999	63,368	29,546	92,914

[1] Includes the catch of Lake Ontario proper and Chaumont Bay in the years from 1913 to 1924, inclusiver Lake Ontario proper in 1925; and Lake Ontario proper, Niagara River below the falls, St. Lawrence Rive; and Chaumont, Black River, Port, Great Sodus and Little Sodus Bays for the years since 1925.
[2] Includes the catch in the Niagara River below the falls.
[3] Does not include the catch in Namakan and Rainy Lakes prior to 1926.
[4] Includes the catch in Lac Suel, Eagle Lake, etc., in the interior of Canada, prior to 1926.

NOTE.—The catch in the Detroit River, St. Clair River, and Lake St. Clair are not included in these statistics.

CATCH: BY SPECIES

[Expressed in thousands of pounds; that is, 000 omitted]

Years	Blue pike			Burbot: United States [1]	Carp			Catfish and bullheads		
	United States	Canada	Total		United States	Canada	Total	United States	Canada	Total
Average, 1913-1915	10,710	2,779	13,489	[2] 65	8,084	1,092	9,176	531	386	917
Average, 1916-1920	3,616	1,932	5,548	[2] 347	5,038	860	5,898	1,206	348	1,554
Average, 1921-1925	9,695	4,492	14,187	320	4,097	433	4,530	845	249	1,094
1926	9,362	3,031	12,393	373	4,649	292	4,941	910	173	1,083
1927	7,324	3,087	10,411	511	3,669	327	3,996	815	151	966
1928	4,842	2,145	6,987	584	1,242	396	1,638	503	301	804

Years	Chubs			Cisco			Lake herring			Sauger: United States [1]
	United States	Canada	Total	United States	Canada	Total	United States	Canada	Total	
Average, 1913-1915	4,321	397	4,718	14,200	7,721	21,921	14,479	2,676	17,155	3,450
Average, 1916-1920	5,250	482	5,732	18,764	9,996	28,760	19,429	4,396	23,825	3,642
Average, 1921-1925	3,163	267	3,430	14,805	6,904	21,709	12,228	1,525	13,753	3,384
1926	6,069	973	7,042	1,449	1,573	3,022	16,522	2,807	19,329	1,634
1927	6,616	1,375	7,991	2,350	2,309	4,659	22,177	3,474	25,651	1,246
1928	5,031	801	5,832	618	1,273	1,891	14,937	4,016	18,953	1,596

[1] The Canadian catch of these species has been included with "Miscellaneous fish."
[2] The catch for Lake Huron was included with "Miscellaneous fish" prior to 1919.

Lake fisheries of the United States and Canada, 1913 to 1928—Continued

CATCH: BY LAKES—Continued

Years	Lake trout			Pike (jacks)			Sturgeon			Sheepshead: United States [1]
	United States	Canada	Total	United States	Canada	Total	United States	Canada	Total	
Average, 1913–1915	10, 554	5, 590	16, 144	509	3, 381	3, 890	84	204	288	1, 697
Average, 1916–1920	10, 559	5, 744	16, 303	456	1, 373	1, 829	62	102	164	2, 503
Average, 1921–1925	10, 510	6, 262	16, 772	376	1, 117	1, 493	27	93	120	2, 114
1926	11, 559	6, 433	17, 992	302	952	1, 254	38	84	122	1, 325
1927	10, 493	7, 077	17, 570	398	1, 099	1, 497	41	77	118	4, 361
1928	9, 418	6, 415	15, 833	531	964	1, 495	30	337	367	2, 934

Years	Sucker "mullet": United States [1]	Tullibees			White bass: United States [1]	Whitefish, common			Whitefish, Menominee: United States [1]
		United States	Canada	Total		United States	Canada	Total	
Average, 1913–1915	4, 566	(3)	189	(3)	566	4, 545	5, 322	9, 867	(4)
Average, 1916–1920	4, 627	(3)	185	(3)	305	4, 900	5, 551	10, 451	(4)
Average, 1921–1925	3, 300	(3)	215	(3)	484	3, 799	6, 038	9, 837	(4)
1926	4, 122	990	164	1, 154	158	5, 148	4, 800	9, 948	(4)
1927	4, 765	662	106	768	126	5, 463	4, 792	10, 255	(4)
1928	3, 995	220	46	266	286	6, 431	4, 392	10, 823	460

Years	Yellow perch			Yellow pike			Miscellaneous fish		
	United States	Canada	Total	United States	Canada	Total	United States	Canada	Total
Average, 1913–1915	5, 974	1, 383	7, 357	2, 725	3, 024	5, 749	4, 906	2, 467	7, 373
Average, 1916–1920	4, 995	1, 521	6, 516	3, 002	1, 663	4, 665	3, 465	2, 842	6, 307
Average, 1921–1925	3, 960	2, 360	6, 320	2, 569	2, 355	4, 924	2, 147	2, 768	4, 915
1926	5, 407	1, 956	7, 363	2, 828	1, 623	4, 451	2, 455	2, 637	5, 092
1927	4, 995	2, 727	7, 722	3, 025	1, 553	4, 578	2, 290	2, 472	4, 762
1928	5, 784	4, 598	10, 382	2, 926	1, 409	4, 335	1, 001	2, 452	3, 453

[1] The Canadian catch of these species has been included with "Miscellaneous fish."
[3] The catch for the United States was included with "Miscellaneous fish" prior to 1925.
[4] Included with "Miscellaneous fish" prior to 1928.

FISHERIES OF THE MISSISSIPPI RIVER AND TRIBUTARIES

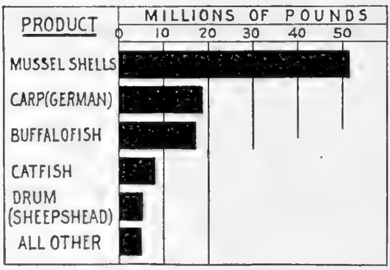

FIGURE 27.—Yield of principal fishery products in the Mississippi River and tributaries, 1922

The latest statistical canvass made of the fisheries and fishery industries of the Mississippi River and tributaries was for the calendar year 1922. The complete statistics for the canvass were published in the report of the division of fishery industries for 1923 and in Statistical Bulletin No. 607. During 1922 the fisheries and fishery industries of this region employed 19,122 persons, and the yield of the fisheries amounted to 105,733,734 pounds, valued at $4,503,521.

Catch of the fisheries of the Mississippi River and tributaries, 1922, with the total catch for certain previous years

Species	Total	
	Pounds	*Value*
Black bass	73,554	$10,874
Bowfin	190,073	6,078
Buffalo fish	17,267,177	1,013,692
Carp, German	18,338,371	872,128
Catfish and bullheads	8,092,690	713,461
Crappie	512,423	49,338
Drum, fresh-water, or sheepshead	5,260,892	290,480
Eels	16,060	1,057
Mooneye or toothed herring	3,450	166
Paddlefish, or spoonbill cat	1,398,991	132,545
Paddlefish caviar	12,398	29,546
Pike and pickerel	20,100	1,850
Pike perch (sauger)	4,745	768
Pike perch (wall-eyed)	24,650	3,750
Quillback, or American carp	765,389	59,221
Rock bass	2,738	312
Sturgeon, lake	10,953	1,369
Sturgeon, shovelnose	227,365	19,323
Sturgeon, shovelnose, caviar	1,880	2,615
Sturgeon, shovelnose, eggs	449	764
Suckers	699,539	$63,028
Sunfish	374,533	24,955
White bass	64,624	5,500
Yellow bass	7,500	600
Yellow perch	22,250	1,904
Other fish	73,275	4,917
Shrimp	147,482	14,570
Crawfish	7,890	759
Frogs	231,761	20,410
Turtles	96,743	2,772
Alligator hides	15,616	2,673
Mussel shells	51,768,173	1,050,592
Pearls		46,124
Slugs		55,380
Total	105,733,734	4,503,521
1894 (all species)	44,544,828	1,384,574
1899 (all species)	96,797,437	1,781,029
1903 (all species)	93,374,159	1,841,168

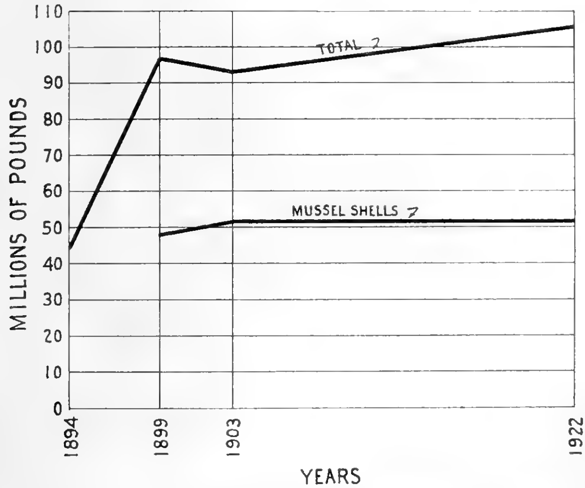

FIGURE 28.—Yield of fishery products in the Mississippi River and tributaries for various years, 1894 to 1922

FRESH-WATER MUSSEL SHELL FISHERY

During 1929 the catch of fresh-water mussel shells in the United States amounted to 54,352,000 pounds, valued at $1,324,919. This represents a decrease of 6 per cent in the catch and an increase of 4 per cent in the value, as compared with the catch and its value in 1922.

Tennessee was the most important producing State during 1929, accounting for 21 per cent of the total catch. Arkansas ranked second with 20 per cent. Other important producing States were Michigan, 10 per cent; Iowa, Indiana, and Illinois, each 8 per cent; and Wisconsin, 7 per cent.

Catch of the fresh-water mussel shell fishery of the United States, 1929

State	Pounds	Value	State	Pounds	Value
Alabama	948,000	$18,058	Missouri	808,000	$15,752
Arkansas	11,032,000	229,121	Ohio	1,266,000	39,743
Illinois	4,252,000	104,266	Oklahoma	36,000	400
Indiana	4,370,000	120,123	South Dakota	746,000	14,271
Iowa	4,380,000	122,429	Tennessee	11,404,000	178,702
Kentucky	1,600,000	28,045	Texas	1,624,000	36,209
Louisiana	1,308,000	24,481	Wisconsin	3,614,000	97,123
Michigan	5,318,000	250,125			
Minnesota	1,184,000	29,666	Total	54,352,000	1,324,919
Mississippi	462,000	16,405			

LAKE PEPIN

The fisheries of Lake Pepin, exclusive of those prosecuted for mussel shells, employed 54 fishermen in 1929 as compared with 124 in 1928. The catch amounted to 390,696 pounds valued at $31,477—a decrease of 46 per cent in the catch and 30 per cent in the value of the catch as compared with the catch and its value for 1928. Compared with 1922 there was a decrease of 89 per cent in the catch. German carp was by far the most important species taken in this lake, constituting 64 per cent of the total catch and 55 per cent of the value of the catch. Fresh-water drum was second in importance accounting for 16 per cent of the catch and 20 per cent of the value. Other species of considerable importance were catfish, buffalofish, and suckers.

OPERATING UNITS BY GEAR

In 1929 the catch of fishery products of Lake Pepin was taken by 30 regular fishermen, 24 casual fishermen, 35 motor boats, 73 other small boats, 19 haul seines having a combined length of 7,782 yards, 81 gill nets having a length of 3,717 yards, 8 lines having a length of 866 yards, 47 fish traps, 101 fyke nets, and 3 spears.

CATCH BY GEAR

Two types of gear accounted for 90 per cent of the fishery products taken in this lake during 1929. By far the most important of these were haul seines which accounted for 67 per cent of the catch and 60 per cent of the value of the catch. Ranked next in importance were fish traps which accounted for 23 per cent of the catch and 31 per cent of the value of the catch.

OPERATING UNITS BY STATES AND COUNTIES

Wisconsin accounted for 95 per cent of the total number of fishermen of Lake Pepin during 1929. Pierce County, in Wisconsin, ranked foremost in this respect accounting for 56 per cent. Wisconsin also accounted for 93 per cent of the fishing boats. Pierce County alone accounted for 53 per cent.

CATCH BY STATES AND COUNTIES

The fisheries of Lake Pepin were prosecuted in two counties in Minnesota and two in Wisconsin during 1929. Pierce County, in Wisconsin, accounted for 56 per cent of the total catch and 46 per cent of the value of the catch. Pepin County in the same State accounted for 36 per cent of the catch and 45 per cent of the value.

Fisheries of Lake Pepin, 1929

OPERATING UNITS AND CATCH: BY GEAR

Items	Haul seines		Gill nets		Lines		Fish traps	
OPERATING UNITS								
Fishermen:		*Number*		*Number*		*Number*		*Number*
Regular		18		2				8
Casual		9		5		3		4
Total		27		7		3		12
Boats:								
Motor		19		10				11
Other		44		14		3		17
Fishing apparatus		19		81		8		47
Length in yards		7,782		3,717		866		
SPECIES	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bowfin	4,622	$143					2,340	$65
Buffalo fish	7,476	776	40	$5			11,470	1,137
Carp, German	208,191	14,370	12,138	1,010	710	$43	8,616	608
Carp, American, or quillback	830	42					851	33
Catfish	4,040	804					15,212	3,485
Drum, fresh-water, or sheepshead	21,192	2,100					40,920	3,998
Paddlefish or spoonbill cat	685	137						
Suckers	13,375	533					10,408	423
Turtles							300	15
Total	260,411	18,905	12,178	1,015	710	43	90,117	9,764

Items	Fyke nets		Spears		Total, exclusive of duplication	
OPERATING UNITS						
Fishermen:		*Number*		*Number*		*Number*
Regular		3				30
Casual		4		3		24
Total		7		3		54
Boats:						
Motor		6				35
Other		11		3		73
Fishing apparatus		101		3		
SPECIES	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bowfin	2,358	$71			9,320	$279
Buffalo fish	1,085	109			20,071	2,027
Carp, German	20,401	1,248	846	$51	250,902	17,330
Carp, American, or quillback					1,681	75
Catfish	1,020	208			20,272	4,497
Drum, fresh-water, or sheepshead	792	40			62,904	6,138
Paddlefish or spoonbill cat					685	137
Suckers	778	23			24,561	979
Turtles					300	15
Total	26,434	1,699	846	51	390,696	31,477

Fisheries of Lake Pepin, 1929—Continued

OPERATING UNITS: BY STATES AND COUNTIES

Items	Minnesota			Wisconsin			Total for lake
	Goodhue County	Wabasha County	Total	Pepin County	Pierce County	Total	
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Regular	1	2	3	12	15	27	30
Casual				9	15	24	24
Total	1	2	3	21	30	51	54
Boats:							
Motor	1	1	2	16	17	33	35
Other	3	3	6	27	40	67	73
Apparatus:							
Haul seines	1	1	2	3	14	17	19
Length, yards	100	667	767	1, 033	5, 982	7, 015	7, 782
Gill nets				81		81	81
Length, yards				3, 717		3, 717	3, 717
Lines					8	8	8
Length, yards					866	866	866
Fish traps				46	1	47	47
Fyke nets				10	91	101	101
Spears					3	3	3

CATCH: BY STATES AND COUNTIES

Species	Minnesota					
	Goodhue County		Wabasha County		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bowfin	260	$13			260	$13
Buffalo fish	1, 400	165	2, 000	$200	3, 400	365
Carp, German	700	35	5, 000	300	5, 700	335
Carp, American, or quillback	830	42			830	42
Catfish	500	100			500	100
Drum, fresh-water, or sheepshead	6, 000	586	10, 000	1, 000	16, 000	1, 586
Suckers	1, 000	41	3, 000	150	4, 000	191
Total	10, 690	982	20, 000	1, 650	30, 690	2, 632

Species	Wisconsin						Total for lake	
	Pepin County		Pierce County		Total			
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bowfin	2, 175	$59	6, 885	$207	9, 060	$266	9, 320	$279
Buffalo fish	12, 849	1, 280	3, 822	382	16, 671	1, 662	20, 071	2, 027
Carp, German	49, 064	4, 093	196, 138	12, 902	245, 202	16, 995	250, 902	17, 330
Carp, American, or quillback	851	33			851	33	1, 681	75
Catfish	17, 534	3, 949	2, 238	448	19, 772	4, 397	20, 272	4, 497
Drum, fresh-water, or sheepshead	43, 660	4, 237	3, 244	315	46, 904	4, 552	62, 904	6, 138
Paddlefish			685	137	685	137	685	137
Suckers	16, 148	656	4, 413	132	20, 561	788	24, 561	979
Turtles	300	15			300	15	300	15
Total	142, 581	14, 322	217, 425	14, 523	360, 006	28, 845	390, 696	31, 477

Operating units and catch of Lake Pepin for various years, 1914 to 1929

Items	1914	1917	1922	1927	1928	1929
OPERATING UNITS	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen	135	126	219	139	124	54
Boats:						
Motor	28	35	109	39	43	35
Other	54	55	136	105	98	73
Fishing apparatus:						
Haul seines	14	17	33	23	27	19
Gill nets	664	371	351	152	127	81
Lines					5	8
Fish traps	8	14			67	47
Fyke nets	295	262	95	280	100	101
Spears			7	4	2	3
SPECIES	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Bowfin	1,534	24,021	16,136	3,334	8,477	9,320
Buffalo fish	261,250	300,808	340,309	33,449	23,992	20,071
Carp, German	237,517	467,588	2,578,916	615,242	488,023	250,902
Carp, American, or quillback	60,605	14,238	47,377	4,835	2,839	1,681
Catfish and bullheads	26,830	254,249	127,384	53,076	52,356	20,272
Drum, fresh-water, or sheepshead	131,785	118,304	395,592	113,793	101,582	62,904
Eels			541	318	235	
Mooneye, fresh	9,300	7,656		8,976	1,600	
Mooneye, smoked	1,465	7,250				
Paddlefish or spoonbill cat	8,877	2,923	15,971	1,191	7,909	685
Pike (grass)	50					
Sturgeon, lake	1,067	512	5,253			
Sturgeon, shovelnose			1,080			
Suckers	18,340	15,260	43,466	31,911	33,645	24,561
Sunfish	50					
Turtles			442			300
Total	758,670	1,212,809	3,572,467	866,125	720,658	390,696

LAKE KEOKUK

The fisheries of Lake Keokuk, exclusive of those for mussel shells, employed 55 fishermen during 1929 as compared with 85 in 1928. The catch amounted to 350,750 pounds, valued at $25,666, which is a decrease of 35 per cent in the catch and 42 per cent in the value of the catch as compared with the catch and its value for 1927. Compared with 1922, there has been a decrease of 50 per cent in the catch. Considered according to the value of the catch German carp and catfish were of about equal importance in these fisheries during 1929, German carp accounting for 51 per cent of the catch and 35 per cent of the value of the catch and catfish accounting for 21 per cent of the catch and 35 per cent of the value of the catch. Buffalo fish ranked next with 12 per cent of the catch and 17 per cent of the value of the catch.

OPERATING UNITS BY GEAR

The catch of fishery products of Lake Keokuk was taken by 49 regular fishermen, 6 casual fishermen, 50 motor boats, 49 other small boats, 5 haul seines having a combined length of 1,450 yards, 28 lines having a length of 8,300 yards, 4 fish traps, 1,485 fyke nets, and 833 baskets.

CATCH BY GEAR

Three types of gear accounted for 96 per cent of the fishery products taken in this lake during 1929. By far the most important of these gears were fyke nets, which accounted for 73 per cent of the catch and 64 per cent of the value of the catch. Ranked next in order were baskets, which accounted for 13 per cent of the catch and 21 per cent of the value, and haul seines accounted for 10 per cent of the catch and 8 per cent of the value.

OPERATING UNITS BY STATES AND COUNTIES

Illinois accounted for 51 per cent of the total number of fishermen employed in the fisheries of Lake Keokuk. The entire activities in this State were confined to Hancock County. Des Moines County, in Iowa, accounted for 36 per cent of the total number of fishermen. Hancock County, in Illinois, also accounted for 52 per cent of the boats operated, and Des Moines County accounted for 40 per cent.

CATCH BY STATES AND COUNTIES

The fisheries of Lake Keokuk were prosecuted in one county in Illinois and two in Iowa. Hancock County in Illinois accounted for 56 per cent of the catch and 57 per cent of the value of the catch, and Des Moines County in Iowa accounted for 26 per cent of the catch and 25 per cent of the value of the catch.

Fisheries of Lake Keokuk, 1929

OPERATING UNITS AND CATCH: BY GEAR

Items	Haul seines		Lines		Fish traps	
OPERATING UNITS						
Fishermen:	*Number*		*Number*		*Number*	
Regular	5		4		2	
Casual	2		3			
Total	7		7		2	
Boats:						
Motor	2		8			
Other	5		6		2	
Fishing apparatus	5		28		4	
Length in yards	1,450		8,300			
SPECIES	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bowfin	150	$5	530	$16	100	$4
Buffalo fish	1,800	196	100	9	2,300	272
Carp, German	23,100	1,210	1,580	79	1,500	90
Catfish	1,100	161	7,000	870	130	25
Drum, fresh-water, or sheepshead	8,650	609	1,380	97	700	92
Mooneye					500	20
White bass					520	63
Total	34,800	2,181	10,590	1,071	5,750	566

Fisheries of Lake Keokuk, 1929—Continued

OPERATING UNITS AND CATCH: BY GEAR—Continued

Items	Fyke nets		Baskets		Total, exclusive of duplication	
OPERATING UNITS						
Fishermen:	*Number*		*Number*		*Number*	
Regular	26		10		49	
Casual			5		6	
Total	26		15		55	
Boats:						
Motor	46		30		50	
Other	47		12		49	
Fishing apparatus	1,485		833			
SPECIES	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bowfin	8,400	$253			9,180	$278
Buffalo fish	38,720	3,859			42,920	4,336
Carp, German	152,200	7,637			178,380	9,016
Carp, American, or quillback	5,700	170			5,700	170
Catfish	21,500	2,424	44,000	$5,432	73,730	8,912
Drum, fresh-water, or sheepshead	28,200	2,000			38,930	2,798
Mooneye					500	20
Paddlefish or spoonbill cat	340	35			340	35
Sunfish	550	38			550	38
White bass					520	63
Total	255,610	16,416	44,000	5,432	350,750	25,666

OPERATING UNITS: BY STATES AND COUNTIES

Items	Illinois: Hancock County	Iowa			Total for lake
		Des Moines County	Lee County	Total	
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*
Regular	24	20	5	25	49
Casual	4		2	2	6
Total	28	20	7	27	55
Boats:					
Motor	28	20	2	22	50
Other	24	20	5	25	49
Apparatus:					
Haul seines			5	5	5
Length, yards			1,450	1,450	1,450
Lines	22	3	3	6	28
Fish traps			4	4	4
Fyke nets	720	580	185	765	1,485
Baskets	623	170	40	210	833

CATCH: BY STATES AND COUNTIES

Species	Illinois: Hancock County		Iowa						Total for lake	
			Des Moines County		Lee County		Total			
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bowfin	7,560	$227	1,370	$42	250	$9	1,620	$51	9,180	$278
Buffalo fish	17,720	1,772	18,000	1,773	7,200	791	25,200	2,564	42,920	4,336
Carp, German	101,840	5,100	39,500	1,977	37,040	1,939	76,540	3,916	178,380	9,016
Carp, American, or quillback			5,700	170			5,700	170	5,700	170
Catfish	51,600	6,471	15,900	1,590	6,230	851	22,130	2,441	73,730	8,912
Drum, fresh-water, or sheepshead	16,080	1,127	10,000	711	12,850	960	22,850	1,671	38,930	2,798
Mooneye					500	20	500	20	500	20
Paddlefish	190	20	150	15			150	15	340	35
Sunfish			450	32	100	6	550	38	550	38
White bass					520	63	520	63	520	63
Total	194,990	14,717	91,070	6,310	64,690	4,639	155,760	10,949	350,750	25,666

Operating units and catch of Lake Keokuk for various years, 1914 to 1929

Items	1914	1917	1922	1927	1928	1929
OPERATING UNITS	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen	105	118	122	102	85	55
Boats:						
Motor	36	52	58	70	56	50
Other	94	80	111	82	70	49
Fishing apparatus:						
Haul seines		1	2	3	4	5
Gill nets		12	235	26	30	
Trammel nets	14	17	17			
Lines [1]					13	28
Fish traps		81		815	7	4
Fyke nets	1,378	1,368	1,301	1,594	1,547	1,485
Dip nets			1			
Baskets					692	833
SPECIES	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Black bass	15	4,163	6,200			
Bowfin		26,000		14,055	13,707	9,180
Buffalo fish	249,900	696,543	113,946	67,872	36,498	42,920
Carp, German	302,365	762,259	276,431	291,199	281,419	178,380
Carp, American, or quillback		5,936		9,880	11,467	5,700
Catfish and bullheads	71,535	109,904	183,919	140,343	163,576	73,730
Crappie	70	17,560	13,770			
Drum, fresh-water, or sheepshead	26,860	160,554	65,040	27,538	16,809	38,930
Eels	3,800	2,087				
Mooneye						500
Paddlefish or spoonbill cat		927	27,405	1,249	157	340
Pike (grass)		20				
Pike, sauger			2,280			
Sturgeon, lake	1,900	454				
Sturgeon, shovelnose			600			
Suckers	4,640	700				
Sunfish	50	13,879	11,590	13,563	14,161	550
White bass						520
Turtles				385		
Total	661,135	1,800,986	701,181	566,084	537,794	350,750

[1] Lines are omitted in 1914, 1917, 1922, and 1927 because data on the number were not available.

MISSISSIPPI RIVER BETWEEN LAKE PEPIN AND LAKE KEOKUK

Statistics of the fisheries of the Mississippi River between Lakes Pepin and Keokuk were obtained for the year 1929 for the first time since they were collected as a part of the complete survey of the Mississippi River and tributaries for 1922. This survey has been made, as were those for Lakes Pepin and Keokuk, primarily to determine the biological and economic effects on the fisheries of this section following the construction of the Keokuk Dam; also, to forecast the probable effects of any subsequently constructed dams in this region.

Considered according to the value of the catch, German carp was the most important fish taken, accounting for 50 per cent of the catch and 36 per cent of the value of the catch. Buffalofish accounted for 22 per cent of the catch and 25 per cent of the value, and catfish and bullheads accounted for 10 per cent of the catch and 25 per cent of the value.

OPERATING UNITS BY GEAR

The catch of fishery products in the Mississippi River between Lakes Pepin and Keokuk was taken by 395 regular fishermen, 280 casual fishermen, 294 motor boats, 316 other small boats, 219 haul seines having a combined length of 39,500 yards, 55 gill nets having a length of 7,168 yards, 127 lines, 80 fish traps, 3,648 fyke nets, 2 dip nets, and 524 baskets.

CATCH BY GEAR

Two types of gear accounted for 90 per cent of the fishery products taken in this region during 1929. First in importance were haul seines which accounted for 57 per cent of the catch and 48 per cent of the value of the catch. Fyke nets ranked next accounting for 33 per cent of the catch and 41 per cent of the value of the catch.

OPERATING UNITS BY STATES

Iowa ranked foremost in the number of persons fishing in that part of the Mississippi River between Lakes Pepin and Keokuk, accounting for 44 per cent of the total, Wisconsin ranked second with 28 per cent, Minnesota third, with 19 per cent, and Illinois fourth, with 9 per cent. Iowa also ranked first in the number of fishing boats accounting for 49 per cent of the total. Wisconsin followed with 25 per cent.

CATCH BY STATES AND COUNTIES

The fisheries of the Mississippi River between Lakes Pepin and Keokuk were prosecuted in 6 counties in Illinois, 8 in Iowa, 3 in Minnesota, and 6 in Wisconsin. The fisheries of Iowa accounted for 52 per cent of the total catch and 50 per cent of the total value of the catch, and those in Wisconsin accounted for 29 per cent of the catch and 25 per cent of the value. Allamakee County, in Iowa, was the most important county, accounting for 21 per cent of the catch and 17 per cent of the value of the catch.

Fisheries of the Mississippi River between Lake Pepin and Lake Keokuk, 1929

OPERATING UNITS AND CATCH: BY GEAR

Items	Haul seines		Gill nets		Lines		Fish traps	
OPERATING UNITS								
Fishermen:	*Number*		*Number*		*Number*		*Number*	
Regular	262		12		16		24	
Casual	179		11		53		2	
Total	441		23		69		26	
Boats:								
Motor	168		12		13		16	
Other	174		13		58		17	
Fishing apparatus	219		55		127		80	
Length, yards	39,500		7,168					
SPECIES	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bowfin	139,517	$6,796			800	$16	4,350	$204
Buffalo fish	348,363	28,378	16,300	$1,304	3,550	285	33,900	2,750
Carp, German	916,431	47,727	29,925	1,496	30,448	1,531	76,950	3,883
Carp, American, or quillback	48,047	2,399	1,900	95	100	5	2,050	108
Catfish and bullheads	97,351	10,754	825	165	15,365	3,031	9,250	1,848
Drum, fresh-water, or sheepshead	149,551	9,022	2,325	116	20,710	1,033	4,688	286
Pickerel	450	38					330	46
Sturgeon	1,190	224	1,000	200	990	190	200	40
Suckers	87,585	4,364	1,300	65	3,500	175	3,790	189
Total	1,788,485	109,702	53,575	3,441	75,463	6,266	135,508	9,354

Fisheries of the Mississippi River between Lake Pepin and Lake Keokuk, 1929—Continued

OPERATING UNITS AND CATCH: BY GEAR—Continued

Items	Fyke nets		Dip nets		Baskets		Total, exclusive of duplication	
OPERATING UNITS								
Fishermen:	*Number*		*Number*		*Number*		*Number*	
Regular	208		2		12		395	
Casual	63						280	
Total	271		2		12		675	
Boats:								
Motor	208				11		294	
Other	130		2		8		316	
Fishing apparatus	3,648		2		524			
SPECIES	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bowfin	1,000	$44					145,667	$7,060
Buffalo fish	283,637	24,986					685,750	57,703
Carp, German	500,404	27,688			850	$51	1,555,008	82,376
Carp, American, or quillback	28,400	1,318					80,497	3,925
Catfish and bullheads	161,556	34,053	100	$18	31,100	7,017	315,547	56,886
Drum, fresh-water, or sheepshead	64,938	4,845	530	58	1,700	188	244,442	15,548
Pickerel	100	11	50	5			930	100
Sturgeon	2,630	373					6,010	1,027
Suckers	7,818	365	30	1			104,023	5,159
Total	1,050,483	93,683	710	82	33,650	7,256	3,137,874	229,784

OPERATING UNITS: BY STATES AND COUNTIES

Items	Illinois							Iowa	
	Carroll County	Henderson County	Jo Daviess County	Mercer County	Rock Island County	Whiteside County	Total	Allamakee County	Clayton County
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Regular	12	10	3	35	1	2	63	57	34
Casual				1			1	19	15
Total	12	10	3	36	1	2	64	76	49
Boats:									
Motor	4	10	3	21	1	1	40	41	22
Other	3	4	2	10		1	20	45	24
Apparatus:									
Haul seines	4			7		1	12	61	13
Length, yards	667			1,226		167	2,060	10,166	3,667
Lines	6	20					26		
Fish traps								22	16
Fyke nets	45	247	30	402	30	6	760	495	560
Baskets	100	406		18			524		

Items	Iowa							Minnesota	
	Clinton County	Dubuque County	Jackson County	Louisa County	Muscatine County	Scott County	Total	Houston County	Wabasha County
Fishermen:	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Regular	24	19	40	4	17	19	214	4	6
Casual	14		7		4	23	82	1	10
Total	38	19	47	4	21	42	296	5	16
Boats:									
Motor	13	11	27	2	15	29	160	3	4
Other	14	9	19	3	10	14	138	4	9
Apparatus:									
Haul seines	7	5	8	1	3	5	103	3	4
Length, yards	1,002	1,667	1,469	100	434	835	19,340	500	1,433
Gill nets		1					1		
Length, yards		1,000					1,000		
Lines	1		14				15	1	4
Fish traps		32	6	2	1		79		
Fyke nets	82	171	523	24	140	230	2,225	20	6
Dip nets		2							

Fisheries of the Mississippi River between Lake Pepin and Lake Keokuk, 1929—Continued

OPERATING UNITS AND CATCH: BY GEAR—Continued

Items	Minnesota—Continued		Wisconsin							Total for region
	Winona County	Total	Buffalo County	Crawford County	Grant County	La Crosse County	Trempealeau County	Vernon County	Total	
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fishermen:										
Regular	18	28	14	15	14	24	6	17	90	395
Casual	86	97	18	21	11	17	6	27	100	280
Total	104	125	32	36	25	41	12	44	190	675
Boats:										
Motor	13	20	10	15	12	24	2	11	74	294
Other	58	71	8	20	13	24	5	17	87	316
Apparatus:										
Haul seines	15	22	10	19	14	23	2	14	82	219
Length, yards	2,500	4,433	1,667	3,167	2,333	3,833	333	2,334	13,667	39,500
Gill nets	1	1		12	2	10	14	15	53	55
Length, yards	667	667		1,200	667	1,667	467	1,500	5,501	7,168
Lines	46	51	6	2			12	15	35	127
Fish traps					1				1	80
Fyke nets	33	93		274	189	19		88	570	3,648
Dip nets										2
Baskets										524

CATCH: BY STATES AND COUNTIES

Species	Illinois							
	Carroll County		Henderson County		Jo Daviess County		Mercer County	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Buffalo fish	10,000	$1,076	5,650	$508	2,900	$399	49,500	$4,545
Carp, German	23,000	2,210	44,850	2,691	950	61	102,900	6,001
Catfish and bullheads	13,000	3,523	39,750	8,699	8,000	2,047	21,150	4,734
Drum, fresh-water or sheepshead	1,700	202	2,650	290	290	47	46,500	4,436
Sturgeon							450	81
Total	47,700	7,011	92,900	12,188	12,140	2,554	220,500	19,797

Species	Illinois					
	Rock Island County		Whiteside County		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Buffalo fish	2,000	$180	3,000	$270	73,050	$6,978
Carp, German	6,000	420	4,000	260	181,700	11,643
Catfish and bullheads			300	70	82,200	19,073
Drum, fresh-water or sheepshead	100	11	800	88	52,040	5,074
Sturgeon					450	81
Total	8,100	611	8,100	688	389,440	42,849

Species	Iowa									
	Allamakee County		Clayton County		Clinton County		Dubuque County		Jackson County	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bowfin	51,476	$2,573	35,400	$1,769			2,150	$106	7,200	$142
Buffalo fish	106,538	8,681	93,633	7,489	15,890	$1,512	42,130	3,442	92,530	8,294
Carp, German	333,608	16,678	175,921	8,794	41,935	2,856	81,100	4,305	132,350	6,548
Carp, American or quillback	20,250	1,017	15,100	754			2,850	142		
Catfish and bullheads	74,162	5,949	28,321	5,663	9,830	2,219	9,300	1,857	24,330	4,407
Drum, fresh-water or sheepshead	43,981	2,198	14,496	723	1,100	121	3,230	223	3,140	313
Pickerel							280	43	650	57
Sturgeon	200	40			340	50			590	69
Suckers	26,949	1,347	5,267	261			4,430	221	1,200	25
Total	657,164	38,483	368,138	25,453	69,095	6,758	145,470	10,339	261,990	19,855

Fisheries of the Mississippi River between Lake Pepin and Lake Keokuk, 1929—Continued

OPERATING UNITS AND CATCH: BY GEAR—Continued

Species	Iowa							
	Louisa County		Muscatine County		Scott County		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bowfin							96, 226	$4, 590
Buffalo fish	5, 500	$530	13, 630	$1, 267	11, 805	$1, 027	381, 656	32, 242
Carp, German	6, 400	369	26, 500	2, 151	25, 195	1, 518	823, 109	43, 237
Carp, American or quillback							38, 200	1, 913
Catfish and bullheads	1, 300	258	7, 880	1, 762	12, 890	2, 631	167, 913	24, 728
Drum, fresh-water or sheepshead	2, 750	288	4, 750	522	2, 300	262	75, 747	4, 650
Pickerel							930	100
Sturgeon	150	24	600	72	1, 230	201	3, 110	456
Suckers					50	1	37, 896	1, 855
Total	16, 100	1, 469	53, 360	5, 774	53, 470	5, 640	1, 624, 787	113, 771

Species	Minnesota							
	Houston County		Wabasha County		Winona County		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bowfin					1, 557	$78	1, 557	$78
Buffalo fish	13, 050	$1, 044	8, 500	$680	15, 657	1, 253	37, 207	2, 977
Carp, German	25, 500	1, 275	12, 000	600	45, 476	2, 273	82, 976	4, 148
Carp, American or quillback	2, 050	102			6, 322	316	8, 372	418
Catfish and bullheads	2, 400	480	2, 075	415	17, 644	3, 529	22, 119	4, 424
Drum, fresh-water or quillback	4, 300	215	23, 800	1, 190	22, 980	1, 149	51, 080	2, 554
Sturgeon			50	10			50	10
Suckers	950	47	6, 300	315	8, 314	415	15, 564	777
Total	48, 250	3, 163	52, 725	3, 210	117, 950	9, 013	218, 925	15, 386

Species	Wisconsin							
	Buffalo County		Crawford County		Grant County		La Crosse County	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bowfin	154	$6	18, 630	$931	1, 500	$75		
Buffalo fish	8, 012	640	44, 700	3, 576	70, 600	5, 648	26, 000	$2, 080
Carp, German	76, 055	3, 803	161, 000	8, 050	56, 500	2, 825	61, 500	3, 075
Carp, American or quillback			16, 875	743	6, 100	304	2, 650	132
Catfish and bullheads	8, 140	1, 628	14, 600	2, 920	5, 400	1, 080	1, 575	315
Drum, fresh-water or quillback	5, 600	280	22, 250	1, 104	4, 725	236	4, 700	235
Suckers	12, 988	649	15, 300	765	2, 025	101	2, 950	147
Total	110, 949	7, 006	293, 355	18, 089	146, 850	10, 269	99, 375	5, 984

Species	Wisconsin						Total for region	
	Trempealeau County		Vernon County		Total			
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bowfin	1, 000	$50	26, 600	$1, 330	47, 884	$2, 392	145, 667	$7, 060
Buffalo fish	2, 525	202	42, 000	3, 360	193, 837	15, 506	685, 750	57, 703
Carp, German	12, 768	638	99, 500	4, 975	467, 323	23, 366	1, 555, 008	82, 376
Carp, American or quillback	3, 000	150	5, 300	265	33, 925	1, 594	80, 497	3, 925
Catfish and bullheads	2, 800	560	10, 700	2, 140	43, 215	8, 643	315, 547	56, 886
Drum, fresh-water or quillback	1, 900	95	26, 400	1, 320	65, 575	3, 270	244, 442	15, 548
Pickerel							930	100
Sturgeon	1, 300	260	1, 100	220	2, 400	480	6, 010	1, 027
Suckers	700	35	16, 600	830	50, 563	2, 527	104, 023	5, 159
Total	25, 993	1, 990	228, 200	14, 440	904, 722	57, 778	3, 137, 874	229, 784

FISHERIES OF ALASKA, 1929

Statistics for the fisheries of Alaska are collected and compiled by the Alaska division of the bureau. A summary of these statistics appears herewith. For the detailed figures the reader is referred to Alaska Fishery and Fur-seal Industries in 1929, by Ward T. Bower, Bureau of Fisheries Document No. 1086.

The fisheries of Alaska during 1929 employed 29,283 persons, of whom 10,921 were fishermen, 16,646 were employed in the wholesale and manufacturing industries, and 1,716 in transporting fishery products. The catch in the round weight, exclusive of whales, amounted to 642,498,047 pounds, valued at $16,582,219. The round weight of whales could not be determined, but their products amounted to 8,925,189 pounds, valued at $502,081. Of the total catch, exclusive of whales, 442,601,784 pounds, valued at $10,843,836, consisted of salmon; 197,887,987 pounds, valued at $5,621,157, consisted of other fish; and 2,008,276 pounds, valued at $117,226, consisted of shellfish.

There were 262 establishments (exclusive of duplication) engaged in the fisheries trade in Alaska in 1929. Of these, 158 canned fish,

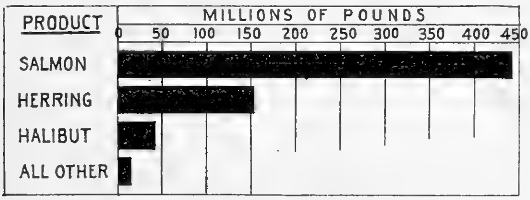

FIGURE 29.—Yield of principal fishery products in Alaska, 1929

103 cured fish, 23 manufactured by-products, and 42 handled fresh and frozen fishery products.

The output of these establishments amounted to 387,593,551 pounds, valued at $50,795,819. The salmon industry was by far the most important and produced 272,244,435 pounds of products, valued at $42,524,845. In value, the halibut industry was next in importance and produced 37,456,998 pounds of products, valued at $4,422,605. The herring industry ranked third and produced 66,577,749 pounds of products, valued at $2,794,084. Of the remainder, whale, clam, and shrimp products were most important in value.

In considering the wholesale and manufacturing industries separately, the canning industry ranked foremost and produced 258,120,063 pounds of fishery products, valued at $40,673,061. In value, fresh fish ranked second, producing 34,179,433 pounds of products, valued at $3,810,010. The by-products industry was third, with products amounting to 61,685,269 pounds, valued at $2,714,674; the cured-fish industry was fourth, with an output of 14,369,167 pounds, valued at $2,038,136; and the frozen-fish industry fifth, accounting for the remainder of the products, amounting to 19,239,619 pounds, valued at $1,559,938.

Fisheries of Alaska, 1929

SUMMARY: BY DISTRICTS

Items	Southeast Alaska		Central Alaska	
PERSONS ENGAGED	*Number*		*Number*	
In fishing	5,420		2,476	
In transporting	920		656	
In wholesale and manufacturing industries	6,876		4,644	
Total	13,216		7,776	
CRAFT EMPLOYED				
Vessels fishing	649		61	
Boats fishing	2,481		1,605	
Vessels transporting	191		142	
Scows, houseboats, pile drivers, etc	423		352	
Total	3,744		2,160	
CATCH				
Fish:	*Pounds*	*Value*	*Pounds*	*Value*
Salmon	153,029,872	$3,941,662	167,594,723	$3,809,149
Other	175,748,141	5,285,980	13,912,108	273,469
Shellfish	1,054,498	53,874	953,778	63,352
Total	329,832,511	9,281,516	182,460,609	4,145,970
	Number		*Number*	
Whales			225	
Wholesale and manufacturing establishments	108		111	
PRODUCTS AS PREPARED FOR MARKET	*Pounds*		*Pounds*	
Salmon	112,502,402	15,457,493	101,123,757	14,937,846
Herring	57,062,696	2,191,258	3,965,351	154,162
Halibut	35,671,973	4,238,872	1,785,025	183,733
Cod			713,838	39,756
Trout	68,656	8,281	28,469	2,978
Sablefish	472,095	22,706		
Smelt	5,166	533		
Rockfish	460	9		
"Lingcod"	39,798	1,108		
Clam			352,239	203,656
Shrimp	497,750	200,312		
Crab	78,519	27,624	132,190	45,241
Whale			4,644,125	266,221
Total	206,399,515	22,148,196	112,744,994	15,833,593

Items	Western Alaska		Total	
PERSONS ENGAGED	*Number*		*Number*	
In fishing	3,025		10,921	
In transporting	140		1,716	
In wholesale and manufacturing industries	5,126		16,646	
Total	8,291		29,283	
CRAFT EMPLOYED				
Vessels fishing	24		734	
Boats fishing	1,334		5,420	
Vessels transporting	83		416	
Scows, houseboats, pile drivers, etc	224		999	
Total	1,665		7,569	
CATCH				
Fish:	*Pounds*	*Value*	*Pounds*	*Value*
Salmon	121,977,189	$3,093,025	442,601,784	$10,843,836
Other	8,227,738	61,708	197,887,987	5,621,157
Shellfish			2,008,276	117,226
Total	130,204,927	3,154,733	642,498,047	16,582,219
	Number		*Number*	
Whales	160		385	
Wholesale and manufacturing establishments	43		262	

Fisheries of Alaska, 1929—Continued

SUMMARY: BY DISTRICTS—Continued

Items	Western Alaska		Total	
PRODUCTS AS PREPARED FOR MARKET	*Pounds*	*Value*	*Pounds*	*Value*
Salmon	58,618,276	$12,129,506	272,244,435	$42,524,845
Herring	5,549,702	448,664	66,577,749	2,794,084
Halibut			37,456,998	4,422,605
Cod			713,838	39,756
Trout			97,125	11,259
Sablefish			472,095	22,706
Smelt			5,166	533
Rockfish			460	9
"Lingcod"			39,798	1,108
Clam			352,239	203,656
Shrimp			497,750	200,312
Crab			210,709	72,865
Whale	4,281,064	235,860	8,925,189	502,081
Total	68,449,042	12,814,030	387,593,551	50,795,819

OPERATING UNITS: BY DISTRICTS

Items	Southeast Alaska	Central Alaska	Western Alaska	Total
	No.	*No.*	*No.*	*No.*
Fishermen	5,420	2,476	3,025	10,921
Vessels fishing:				
Steam	1	3	4	8
Net tonnage	70	207	340	617
Motor	648	58	20	726
Net tonnage	10,596	843	553	11,992
Boats fishing:				
Motor	1,148	657	56	1,861
Other	1,333	948	1,278	3,559
Apparatus:				
Traps	444	268	2	714
Purse seines	527	159	17	703
Yards	184,126	32,740	7,560	224,426
Haul seines	5	166	5	176
Yards	1,000	38,298	580	39,878
Gill nets	321	1,808	2,096	4,225
Yards	50,960	196,060	340,300	587,320
Beam trawls	9			9

Items	Southeast Alaska	Central Alaska	Western Alaska	Total
Apparatus—Con.	*No.*	*No.*	*No.*	*No.*
Wheels			246	246
Lines—				
Hand lines (cod fishery)		91		91
Trawl lines (cod fishery)		44		44
Troll lines (salmon fishery)	3,386	4		3,390
Skates of lines (halibut fishery)	7,150			7,150
Crab pots	340	400		740
Herring pounds	9	5	6	20

CATCH: BY DISTRICTS

[Estimated round weight and value to fishermen]

Items	Southeast Alaska		Central Alaska	
FISH	*Pounds*	*Value*	*Pounds*	*Value*
Salmon:				
Coho or silver	10,947,536	$272,831	6,085,952	$140,601
Chum or keta	23,642,145	406,901	45,944,640	676,101
Pink or humpback	96,133,374	2,388,518	73,977,864	1,591,284
King or spring	8,935,620	380,583	2,846,120	135,870
Red or sockeye	13,371,197	492,829	38,740,147	1,265,293
Herring	135,262,853	1,014,471	9,615,161	72,114
Halibut	39,635,526	4,238,872	1,983,361	183,733
Cod			2,277,945	14,644
Trout:				
Dolly Varden	37,749	4,687	35,641	2,978
Steelhead	48,071	3,594		
Sablefish	694,257	22,706		
Smelt	7,749	533		
Rockfishes	708	9		
"Lingcod"	61,228	1,108		
Total	328,778,013	9,227,642	181,506,831	4,082,618
SHELLFISH				
Crabs	149,498	13,812	249,330	22,621
Shrimp	905,000	40,062		
Clams, razor			704,448	40,731
Total	1,054,498	53,874	953,778	63,352
Grand total	329,832,511	9,281,516	182,460,609	4,145,970

Fisheries of Alaska, 1929—Continued

CATCH: BY DISTRICTS—Continued

[Estimated round weight and value to fisherman]

Items	Western Alaska		Total	
FISH	Pounds	Value	Pounds	Value
Salmon:				
Coho or silver	244, 104	$5, 162	17, 277, 592	$418, 594
Chum or keta	14, 965, 002	135, 534	84, 551, 787	1, 218, 536
Pink or humpback	356, 688	4, 519	170, 467, 926	3, 984, 321
King or spring	3, 406, 720	72, 404	15, 188, 460	588, 857
Red or sockeye	103, 004, 675	2, 875, 406	155, 116, 019	4, 633, 528
Herring	8, 227, 738	61, 708	153, 105, 752	1, 148, 293
Halibut			41, 618, 887	4, 422, 605
Cod			2, 277, 945	14, 644
Trout:				
Dolly Varden			73, 390	7, 665
Steelhead			48, 071	3, 594
Sablefish			694, 257	22, 706
Smelt			7, 749	533
Rockfishes			708	9
"Lingcod"			61, 228	1, 108
Total	130, 204, 927	3, 154, 733	640, 489, 771	16, 464, 993
SHELLFISH				
Crabs			398, 828	36, 433
Shrimp			905, 000	40, 062
Clams, razor			704, 448	40, 731
Total			2, 008, 276	117, 226
Grand total	130, 204, 927	3, 154, 733	642, 498, 047	16, 582, 219

NOTE.—In addition to the above statistics, 385 whales were taken in Alaskan waters. The round weight and value to fishermen can not be determined, but the products amounted to 8,925,189 pounds, valued at $502,081.

Industries related to the fisheries of Alaska, 1929

TRANSPORTING

Items	Southeast Alaska	Central Alaska	Western Alaska	Total
Persons engaged	920	656	140	1, 716
Vessels transporting:				
Steam	2	3	19	24
Net tonnage	128	5, 530	26, 757	32, 415
Motor	189	138	63	390
Net tonnage	6, 594	3, 903	3, 764	14, 261
Sail		1	1	2
Net tonnage		1, 590	1, 965	3, 555
Vessels transporting—Continued.				
Scows, houseboats, pile drivers, etc	423	352	224	999

WHOLESALE AND PREPARED PRODUCTS AND BY-PRODUCTS TRADES

Items	Southeast Alaska	Central Alaska	Western Alaska	Total
	Number	Number	Number	Number
Persons engaged	6, 876	4, 644	5, 126	16, 646
Establishments:				
Handling fresh and frozen fish	36	6		42
Curing fish	42	45	16	103
Canning fish	59	70	29	158
Manufacturing by-products	14	8	1	23
Total (exclusive of duplication)	108	111	43	262

Industries related to the fisheries of Alaska, 1929—Continued

PRODUCTS AS PREPARED FOR MARKET

Items	Southeast Alaska		Central Alaska	
	Pounds	*Value*	*Pounds*	*Value*
FRESH				
Salmon (all species)	1,195,012	$108,373	17,000	$2,300
Herring (for bait)	4,043,990	51,553	457,800	6,863
Halibut	27,683,371	3,359,217	3,000	450
Trout	42,540	6,203	6,200	1,000
Sablefish	4,321	157		
Smelt	3,880	392		
Rockfishes	460	9		
"Lingcod"	13,400	316		
Crabs:				
Meat	70,979	26,870	117,140	44,513
Whole in shell	7,540	754	15,050	728
Shrimp, cooked	497,750	200,312		
Total	33,563,243	3,754,156	616,190	55,854
FROZEN				
Salmon (all species)	4,390,289	428,348	4,880	270
Herring (for bait)	4,352,495	34,729	23,600	590
Herring (for food)	47,200	1,416		
Halibut	7,988,602	879,655	1,782,025	183,283
Trout	26,116	2,078	22,077	1,958
Sablefish	462,174	22,129		
Smelt	1,286	141		
"Lingcod"	26,398	792		
Total	17,294,560	1,369,288	1,832,582	186,101
CURED				
Salmon:				
Mild cured	4,318,400	1,200,147	228,800	41,576
Pickled	77,800	8,040	272,300	35,963
Dried, smoked, and dry salted	3,123	165	2,300	345
Herring:				
Pickled (for food)—				
Scotch cure	1,244,250	88,609	200,250	13,660
Norwegian cure	91,165	5,703		
Spiced	9,200	1,010		
Cod:				
Dry salted			704,538	38,306
Stockfish			8,700	1,370
Tongues			600	80
Sablefish: Pickled	5,600	420		
Total	5,749,538	1,304,094	1,417,488	131,300
CANNED				
Salmon:				
Coho, or silver	4,696,656	755,176	3,423,840	529,130
Chum, or keta	13,958,256	1,573,384	23,893,152	2,645,877
Pink, or humpback	74,045,520	9,330,206	49,231,296	6,231,430
King, or spring	336,000	86,378	1,711,728	495,686
Red, or sockeye	7,821,696	1,915,377	21,796,128	4,935,862
Trout			192	20
Clams			352,239	203,656
Total	100,858,128	13,660,521	100,408,575	15,041,661
BY-PRODUCTS				
Fertilizer:				
Salmon	1,245,200	31,364	401,970	10,049
Whale			1,352,000	35,015
Meal, herring	23,872,093	691,484	1,627,161	42,762
Oil:				
Salmon	414,450	20,535	140,363	9,358
Herring	23,402,303	1,316,754	1,656,540	90,287
Whale			3,200,250	226,706
Sperm			91,875	4,500
Total	48,934,046	2,060,137	8,470,159	418,677
Grand total	206,399,515	22,148,196	112,744,994	15,833,593

Industries related to the fisheries of Alaska, 1929—Continued

PRODUCTS AS PREPARED FOR MARKET—Continued

Items	Western Alaska		Total	
	Pounds	*Value*	*Pounds*	*Value*
FRESH				
Salmon (all species)			1,212,012	$110,673
Herring (for bait)			4,501,790	58,416
Halibut			27,686,371	3,359,667
Trout			48,740	7,203
Sablefish			4,321	157
Smelt			3,880	392
Rockfishes			460	9
"Lingcod"			13,400	316
Crabs:				
Meat			188,119	71,383
Whole in shell			22,590	1,482
Shrimp, cooked			497,750	200,312
Total			34,179,433	3,810,010
FROZEN				
Salmon (all species)			4,395,169	428,618
Herring (for bait)	43,000	$1,075	4,419,095	36,394
Herring (for food)	69,477	3,474	116,677	4,890
Halibut			9,770,627	1,062,938
Trout			48,193	4,036
Sablefish			462,174	22,129
Smelt			1,286	141
"Lingcod"			26,398	792
Total	112,477	4,549	19,239,619	1,559,938
CURED				
Salmon:				
Mild cured			4,547,200	1,241,723
Pickled	331,300	29,017	681,400	73,020
Dried, smoked, and dry salted	1,433,616	129,610	1,439,039	130,120
Herring:				
Pickled (for food)—				
Scotch cure	5,100,625	425,115	6,545,125	527,384
Norwegian cure	37,400	3,500	128,565	9,203
Roused	149,200	7,500	149,200	7,500
Spiced			9,200	1,010
Dry salted	150,000	8,000	150,000	8,000
Cod:				
Dry salted			704,538	38,306
Stockfish			8,700	1,370
Tongues			600	80
Sablefish: Pickled			5,600	420
Total	7,202,141	602,742	14,369,167	2,038,136
CANNED				
Salmon:				
Coho, or silver	133,392	20,151	8,253,888	1,304,457
Chum, or keta	3,645,168	402,090	41,496,576	4,621,351
Pink, or humpback	162,720	17,720	123,439,536	15,579,356
King, or spring	1,413,408	277,732	3,461,136	859,796
Red, or sockeye	51,498,672	11,253,186	81,116,496	18,104,425
Trout			192	20
Clams			352,239	203,656
Total	56,853,360	11,970,879	258,120,063	40,673,061
BY-PRODUCTS				
Fertilizer:				
Salmon			1,647,170	41,413
Whale	1,270,000	33,575	2,622,000	68,590
Meal, herring			25,499,254	734,246
Whalebone	16,000	800	16,000	800
Pickled whale meat	36,314	1,500	36,314	1,500
Oil:				
Salmon			554,813	29,893
Herring			25,058,843	1,407,041
Whale	2,692,500	186,685	5,892,750	413,391
Sperm	266,250	13,300	358,125	17,800
Total	4,281,064	235,860	61,685,269	2,714,674
Grand total	68,449,042	12,814,030	387,593,551	50,795,819

NOTE.—Halibut products include all taken by the Alaska fleet, some of which were landed at other than Alaska ports. The total landings in Alaska in 1929 amounted to 13,841,874 pounds, valued at $1,424,623 (including 8,000 pounds, valued at $1,000, landed by Canadian vessels), as compared with 9,805,000 pounds, valued at $757,000 in 1928.

Industries related to the fisheries of Alaska, 1929—Continued

SUPPLEMENTARY TABLE SHOWING THE PACK OF CANNED PRODUCTS IN "STANDARD CASES"[1]

Items	Southeast Alaska		Central Alaska		Western Alaska		Total	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Value*
Salmon:								
Coho, or silver	97,847	$755,176	71,330	$529,130	2,779	$20,151	171,956	$1,304,457
Chum, or keta	290,797	1,573,384	497,774	2,645,877	75,941	402,090	864,512	4,621,351
Pink, or humpback	1,542,615	9,330,206	1,025,652	6,231,430	3,390	17,720	2,571,657	15,579,356
King, or spring	7,000	86,378	35,661	495,686	29,446	277,732	72,107	859,796
Red, or sockeye	162,952	1,915,377	454,086	4,935,862	1,072,889	11,253,186	1,689,927	18,104,425
Trout			4	20			4	20
Clams			23,482	203,656			23,482	203,656
Total	2,101,211	13,660,521	2,107,989	15,041,661	1,184,445	11,970,879	5,393,645	40,673,061

SUPPLEMENTARY TABLE SHOWING THE OUTPUT OF BY-PRODUCTS IN TONS AND GALLONS

Items	Southeast Alaska		Central Alaska		Western Alaska		Total	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Fertilizer:								
Salmon ... tons	623	$31,364	201	$10,049			824	$41,413
Whale ... do			676	35,015	635	$33,575	1,311	68,590
Meal, herring ... do	11,936	691,484	814	42,762			12,750	734,246
Whalebone ... do					8	800	8	800
Pickled whale meat ... do					18	1,500	18	1,500
Oil:								
Salmon ... gallons	55,260	20,535	18,715	9,358			73,975	29,893
Herring ... do	3,120,307	1,316,754	220,872	90,287			3,341,179	1,407,041
Whale ... do			426,700	226,706	359,000	186,685	785,700	413,391
Sperm ... do			12,250	4,500	35,500	13,300	47,750	17,800
Total		2,060,137		418,677		235,860		2,714,674

[1] The pack of salmon and trout has been converted to "standard cases" of forty-eight 1-pound cans, and clams to "standard cases" of 48 No. 1 5-ounce cans.

COMMON AND SCIENTIFIC NAMES OF FISHERY PRODUCTS

In order to prevent misunderstanding from the use of common names employed in the tables and discussions, the following list of common and scientific names is given.

Common and scientific names of the commercial fishery products caught in the United States and Alaska

Common name as shown in bureau reports	Other common names	Scientific names
Albacore	Longfin tuna	*Germo alalunga.*
Alewives	Branch herring, wall-eyed or big-eyed herring.	*Pomolobus pseudoharengus.*
	Blueback, glut herring	*Pomolobus æstivalis.*
Amberjack		Seriola sp.
Anchovies		*Engraulis mordax.*
		Anchoviella delicatissima.
		Anchoviella compressa.
Angelfish		*Pomacanthus arcuatus.*
		Angelichthys isabelita.
Barracuda		*Sphyræna argentea* (Pacific coast).
		Sphyræna barracuda (Atlantic coast).
Black bass	Smallmouth bass	*Micropterus dolomieu.*
	Largemouth bass	*Micropterus salmoides.*
Bluefish	Tailor	*Pomatomus saltatrix.*
Blue pike	Pike perch, blue pickerel (Canada)	*Stizostedion glaucum.*
Blue runner or hardtail	Runner	*Caranx crysos.*
Bonito		*Sarda sarda.*
		Euthynnus pelamis.
Bowfin		*Amia calva.*
Buffalo fish		Ictiobus sp.
Bullhead		Ameiurus sp.

Common and scientific names of the commercial fishery products caught in the United States and Alaska—Continued

Common name as shown in bureau reports	Other common names	Scientific names
Butterfish	Dollarfish	*Poronotus triacanthus.*
Burbot	Lawyer, ling	*Lota maculosa.*
Cabio	Coal-fish, crab eater, cobia	*Rachycentron canadum.*
Carp (German)		*Cyprinus carpio.*
Catfish		Siluridæ sp.
Cero		*Scomberomonus regalis.*
Chubs	Tullibee in Canada; longjaws, bluefin, blackfin in United States.	All Leucichthys except *artedi* (in Great Lakes).
Cisco	Herring in Canada	*Leucichthys artedi* (Lake Erie only).
Cod	Codfish	*Gadus macrocephalus* (Pacific coast). *Gadus callarias* (Atlantic coast).
Cowfish	Trunkfish, chapin	Ostracion sp.
Crappie	White crappie	*Pomoxis annularis.*
	Black crappie, strawberry bass, calico bass.	*Pomoxis sparoides.*
Crevalle		*Caranx hippos.*
Croaker	Crocus, hardhead	*Micropogon undulatus.*
Cunner	Chogset, blue perch, bergall	*Tautogolabrus adspersus.*
Cusk		*Brosmius brosme.*
Dolly Varden trout	Salmon trout, bull trout	*Salvelinus parkei.*
Dolphin		*Coryphaena hippurus.*
Drum, fresh-water, or sheepshead.	White perch, gaspergou	*Aplodinotus grunniens.*
Drum, black		*Pogonias cromis.*
Drum, red	Channel bass, redfish, spotted bass	*Sciænops ocellatus.*
Eels		*Anguilla rostrata.* *Leptocephalus conger.* *Gymnothorax mordax.* *Gymnothorax moringua.*
Eulachon	Candlefish	*Thaleichthys pacificus.*
Flounders	Dabs, blackbacks, lemon sole, winter flounder, summer flounder.	Pleuronectidae sp.
Flying fish		*Cypsilurus californicus.*
Frigate mackerel		*Auxis thazard.*
Garfish		Tylosurus sp. Ablennes sp.
Gizzard shad	Nanny shad, mud shad	*Dorosoma cepedianum.*
Goldfish	Sand perch	*Carassius auratus.*
Goosefish		*Lophius piscatorius.*
Grayfish	Dogfish	*Squalus sucklii* (Pacific coast).
	Spiny dog	*Squalus acanthias.*
	Smooth dog	*Galeohinus lævis.*
Greenfish	Rudderfish	*Girella nigricans.*
Groupers		Epinephelus sp. Mycteroperca sp.
Grunts	Margatefish, sailor's choice (Key West).	Hæmulon sp.
Haddock		*Melanogrammus aegilfinus.*
Hake	Squirrel hake, Boston hake, ling, black hake, mud hake.	Urophycis sp. (Atlantic coast).
	Merluccio	*Merlucius productus* (Pacific coast)
Halfmoon		*Medialuna californiensis.*
Halibut		*Hippoglossus hippoglossus.*
Halibut, "California"		*Paralichthys californicus.*
Hardhead		*Orthodon microlepidolus.*
Harvestfish	Starfish, pappyfish	*Peprilus alepidotus.*
Herring		*Clupea harengus* (Atlantic coast). *Clupea pallasii* (Pacific coast).
Hickory shad	Tailor shad	*Pomolobus mediocris.*
Hog-choker		*Achirus fasciatus.*
Hogfish	Capitaine, perro perro	*Lachnolaimus maximus* (Florida)
Horse mackerel		*Trachurus symmetricus.*
Jewfish		*Promicrops itaiara.*
Kingfish		*Scomberomorus cavalla.*
Kingfish (California)	Little roncador, croaker	*Genyonemus lineatus.*
King whiting	Northern whiting, kingfish, sea mink	Menticirrhus sp.
Ladyfish	Bonefish, banana fish	*Albula vulpes.*
Lake herring	Herring	*Leucichthys artedi* (Great Lakes, except Erie).
Lake trout		*Cristivomer namaycush.*
Launce	Sand eel, lant, sand launce	*Ammodytes americanus.*
"Lingcod"	Cultus cod, blue cod, buffalo cod, ling	*Ophiodon elongatus.*
Mackerel		*Scomber scombrus* (Atlantic coast). *Scomber diego* (Pacific coast).
Menhaden	Mossbunker, pogy	*Brevoortia tyrannus.*
Minnows		Cyprinidae sp.
Mojarro		Eucinostomus sp.
Moon-eye	Toothed herring	Hiodon sp.
Moonfish		*Vomer setipinnis.* *Selene vomer.*

Common and scientific names of the commercial fishery products caught in the United States and Alaska—Continued

Common name as shown in bureau reports	Other common names	Scientific names
Mullet	Jumping mullet	Mugil sp.
Mummichog	Mayfish, killifish	Fundulus sp.
Muttonfish		*Lutianus analis.*
Paddlefish	Spoonbill cat	*Polyodon spathula.*
Parrotfish		Scaridæ sp.
Perch, white	White perch	*Morone americana.*
	Blue perch, surf-fishes	Embiotocidæ sp. (Pacific coast).
Perch, yellow	Winged perch	*Perca flavescens.*
Permit	Great pompano	*Trachinotus goodei.*
Pickerel		*Esox reticulatus.*
		Esox americanus.
Pigfish		*Orthopristis chrysopterus.*
Pike (jacks)	Great Lakes pike, pickerel	*Esox lucius.*
Pilchard	Sardine	*Sardinia cærulea.*
Pilotfish		*Naucrates ductor.*
Pinfish	Bream, salt-water bream	*Lagodon rhomboides.*
Pollock		*Pollachius virens.*
Pompano		Trachinotus sp. (Atlantic coast).
		Palometa simillimus (Pacific coast).
Porgies	Porgee	Calamus sp.
Porkfish	Sisi	*Anisotremus virginicus.*
Quillback	Spearfish or skimfish	Carpiodes sp.
Roach	Shiner	*Notemigonus crysoleucas.*
Rock bass	Sand bass	Paralabrax sp. (Pacific coast).
	Red-eye, goggle-eye	*Ambloplites rupestris* (Mississippi River and tributaries).
Rockfishes	Rock cod	Sebestodes sp. (Pacific coast).
Rosefish		*Sebastes marinus.*
Sablefish	Black cod	*Anaplopoma fimbria.*
Salmon:		
Atlantic		*Salmo salar* (Atlantic coast).
Pacific—		
King, chinook, or spring.	Tyee, Columbia, Sacramento	*Oncorhynchus tschawytscha.*
Red or sockeye	Blueback	*Oncorhynchus nerka.*
Coho or silver		*Oncorhynchus kisutch.*
Humpback or pink.		*Oncorhynchus gorbuscha.*
Chum or keta	Dog salmon	*Oncorhynchus keta.*
Steelhead		(See steelhead trout.)
Sauger pike	Sand pike	*Stizostedion canadense.*
Sawfish		*Pristis pectinatus.*
Scamp		*Mycteroperca phenax.*
Sculpin		Cottidæ sp.
Scup	Paugy or porgy, fair maid	*Stenotomus chrysops.*
Sea bass	Black jewfish or black sea bass	*Stereolepis gigas* (Pacific coast).
	Black sea bass	*Centropristes striatus* (Atlantic coast).
Sea bass, white (California)		*Cynoscion nobilis* (Pacific coast).
Sea gar	Needlefish, billfish, houndfish	Tylosurus sp.
Sea robin		Prionotus sp.
Shad	American shad	*Alosa sapidissima.*
Sharks		Carcharodon sp.; Mustelus sp.; Carcharhinus sp.; Sphyrna sp.
Sheepshead (salt-water)		*Archosargus probatocephalus.*
Sheepshead (fresh-water)	Drum, fresh-water	*Aplodinotus grunniens.*
Sheepshead (Pacific coast)	Redfish, flat head	*Pimelometopon pulcher.*
Silversides	Spearing	Menidia sp.
Silver perch	Sand perch	*Bairdiella chrysura.*
Skates		Raja sp.
Skipjack	Striped tuna	*Sarda chilensis.*
Skipper	"Billfish"	*Scomberesox saurus.*
Smelt		*Osmerus mordax* (Atlantic coast).
		Argentinidæ sp. (Pacific coast).
Snapper, Mangrove	Gray snapper	*Lutianus griseus.*
Snapper, red		*Lutianus blackfordii.*
Snook	Robalo, sergeantfish	*Centropomus undecimalis.*
Sole		*Psettichthys melanostictus* (Pacific coast).
Spadefish		*Chædipterus faber.*
Spanish mackerel		*Scomberomorus maculatus.*
Splittail		*Pogonichthys macrolepidotus.*
Spot	Lafayette, goody	*Leiostomus xanthurus.*
Squawfish	Sacramento pike	*Ptychocheilus oregonensis.*
Squeteague (gray)	Gray trout, weakfish, trout	*Cynoscion regalis.*
Squeteague (spotted)	Spotted weakfish, spotted trout	*Cynoscion nebulosus.*
Squirrelfish		*Diplectrum formosum.*
Steelhead trout	Salmon trout	*Salmo gairdneri.*
Stingray		Dasyatis sp.
Striped bass	Rockfish, rock	*Roccus lineatus.*
Sturgeon		Acipenser sp.

Common and scientific names of the commercial fishery products caught in the United States and Alaska—Continued

Common name as shown in bureau reports	Other common names	Scientific names
Sturgeon, shovel-nosed		*Scaphirhynchus platorynchus.*
Sucker	Fresh-water mullet	Catostomidæ sp.
Sunfish		Lepomis sp. Centrarchidæ sp.
Swellfish	Puffer, swell toad, balloonfish, globefish.	*Spheroides maculatus.*
Swordfish		*Xiphias gladius.*
Tang		Hepatus sp.
Tarpon	Silver king	*Tarpon atlanticus.*
Tautog	Blackfish, oysterfish	*Tautoga onitis.*
Ten-pounder	Elops	*Elops saurus.*
Thimble-eyed mackerel	Bull's-eye	*Scomber colias.*
Tilefish		*Lopholatilus chamæleonticeps.*
Tomcod		*Microgadus tomcod* (Atlantic coast). *Microgadus proximus* (Pacific coast).
Tripletail		*Lobotes surinamensis.*
Tuna	Blufin tuna, tunny, horse mackerel, leaping tuna.	*Thunnus thynnus.*
Turbot	Greenland halibut, American turbot	*Reinharditus hippoglossoides.* *Balistes carolinensis.*
White bass	White lake bass	*Roccus chrysops.*
White bait		Small fry of any fish.
Whitefish		*Coregonus clupeiformis* (Great Lakes). *Caulolatilus princeps* (Pacific coast).
Whitefish (Menominee)		*Coregonus clupeaformis.*
Whiting	Silver hake	*Merluccius bilinearis.*
Wolffish		*Anarrhichas lupus.*
Yellow bass		*Morone interrupta.*
Yellow perch		*Perca flavescens.*
Yellow pike	Wall-eyed pike, pike perch, dore	*Stizostedion vitreum.*
Yellow fin tuna		*Neothunnus macropterus.*
Yellowtail		*Ocyurus chrysurus* (Atlantic coast). *Seriola dorsalis* (Pacific coast).
Abalone		Halotis sp.
Clams:		
Hard	Round clam, cherrystone, quahog, little neck.	*Tivela stultorum* (Pacific coast). *Venus mercenaria* (Atlantic coast). *Venus mortoni* (Florida coast).
Cockle		*Cardium corbis.*
Soft	Sand clam, soft-shelled clam, nannynose, maninose.	*Mya arenaria.*
Razor (Atlantic)		Siliqua sp.; Tagelus sp.
Razor (Pacific)		*Siliqua patula.*
Pismo		*Tivela stultorum* (Pacific coast).
Conchs		Strombus sp. Busycon sp.
Crabs:		
Stone		*Menippi mercenaria.*
Soft	Soft-shelled crab, blue crab	*Callinectes sapidus.*
Hard	Hardshell crab, blue crab Dungeness crab Rock crab, hard crab	Do. *Cancer magister* (Pacific coast). *Cancer irroratus* (Atlantic coast).
King	Horseshoe crab	Limulus.
Spider	Toad crab	*Hyas coarctatus.*
Crawfish	Crayfish	Cambarus sp. (Atlantic coast). Astacus sp. (Pacific coast).
Lobsters:		
Common		*Homarus americanus* (Atlantic coast).
Spiny	Rock lobster, crayfish	*Panulirus interruptus* (Pacific coast). *Panulirus argus* (Atlantic coast).
Mussels		*Mytilus californianus* (Pacific coast). *Mytilus edulis.*
Octopus		*Octopus punctatus* (Pacific coast).
Oysters:		
Eastern		*Ostrea elongata.*
Western	Olympia	*Ostrea lurida* (Pacific coast).
Japanese (introduced)		*Ostrea gigas.*
Periwinkles		Littorina sp.
Scallops:		
Sea		*Pecten magellanicus.*
Bay		*Pecten irradians* (Atlantic coast). *Pecten æquisulcatus* (Pacific coast).
Shrimp		*Peneus setiferus.* *Peneus brasiliensis* (Atlantic and Gulf coasts). Pandalus sp. (Pacific coast). Pandalopsis sp. (Pacific coast). Crangon sp. (Pacific coast).
Snails		Gastropoda sp.

Common and scientific names of the commercial fishery products caught in the United States and Alaska—Continued

Common name as shown in bureau reports	Other common names	Scientific names
Squid		*Loligo opalescens* (Pacific coast). *Loligo pealei* (Atlantic coast).
Turtles:		
Green		*Chelonia mydas.*
Loggerhead		*Thalassochelys caretta.*
Hawksbill		*Chelonia inbricata.*
Snapping	Mud turtle, mossback	*Chelydra serpentina.*
Terrapin	Diamond-back terrapin	*Malacoclemmys palustris.*
Frogs		Rana sp.
Irish moss		*Chondrus crispus.*
Kelp		Macrocystis sp; Nereocystis sp.; Pelagophycus sp.; Alaria sp.
Sponges:		
Glove		*Spongia graminea* (Hyatt) *Euspongia officinalis* (L.).
Grass		*Hippospongia equina cerebriformis.*
Sheepswool		*Hippospongia canaliculata gossypina.*
Yellow		*Hippospongia equina elastica.*
Tiepang	Sea cucumber	*Cucumaris frondosa; Thyone briareus.*

METHODS USED IN COLLECTING STATISTICS

In order that persons using the statistics in this report may judge as to their completeness and authenticity, there follows an outline of the methods employed by the bureau in collecting fishery statistics. It will be noted that several methods are used. Each, in so far as possible, is the most efficient that can be developed to accomplish the desired result with the available personnel.

General fishery statistics.—The purpose of collecting general fishery statistics is to obtain statistics on the catch of fishery products and its value as landed by the fishermen, the quantity or number of each kind of gear used, the number of fishing boats, the number and net tonnage of fishing and transporting vessels, the number of wholesale establishments, the amount of wages and salaries paid in these establishments, the quantity and value of products prepared, and the number of persons engaged in each phase of the industry.

The scope of the coastal surveys includes the commercial fisheries of the oceans, bays, and coastal rivers as far inland as commercial fishing is important. This usually coincides with the range of commercial fishing for anadromous species. Statistics of the fisheries of the Mississippi River include the fisheries of the Mississippi River proper, as well as all tributaries wherein commercial fishing for either fish, crustaceans, or mollusks is prosecuted. Statistics of the lake fisheries include those prosecuted in the Great Lakes, adjacent bays, and the international lakes of northern Minnesota, as well as certain rivers having outlets into these waters.

General statistics of the fisheries of the United States are not collected each year, but each year statistics are collected for several geographical sections. The aggregate of these statistics for the various years is taken to represent an average year.

In conducting these surveys it is the custom of the bureau to dispatch agents to the districts to be surveyed early in the calendar year. They obtain statistics on operations during the previous calendar year, except that statistics of the oyster fishery are obtained for the season ending in the spring of the following year. The agents conducting these surveys are trained men or recruits working under the close supervision of trained men. Recruits are permitted to work individually only after proving a satisfactory aptitude for the work during their training period. While it is impossible for the few agents available to interview each fisherman in a given locality, the more important ones are visited and a sufficient number of those of lesser importance are interviewed to obtain reliable information on their production. In practice, virtually all wholesale firms are visited, as well as captains of fishing vessels (those of 5 net tons or over) and also all the more important shore fishermen and representative small producers.

As an aid in locating fishermen, lists of vessel and motor-boat owners are obtained from local customs houses. It is also often possible to obtain the names of licensed commercial fishermen and occasionally some statistics of the catch from the various State fishery agencies. In the Great Lakes and Pacific Coast States such exceptional cooperation has been obtained from the State agencies in recent years that only fragmentary surveys are made by the bureau to supplement missing data.

For the Great Lakes and international lakes of northern Minnesota the bureau obtains catch statistics and usually the value of the catch direct from the State records. To obtain data on the fishermen, boats, vessels, and gear the bureau conducts such personal surveys among the fishermen as may be necessary to supplement the State records. Statistics of the wholesale industry have not been obtained since 1922. Annual catch statistics are available since 1913.

Agents are stationed at Seattle, Wash., who survey each of the Pacific Coast States annually to supplement data that are missing from the State records. In most cases the value of the catch is derived from dealers' records and from estimates of prices. In Washington and Oregon the offshore fisheries are surveyed separately for units of operation, catch, and value of the catch. In almost all other respects the statistics are as collected by the States. Statistics of the wholesale industry for this district are obtained largely by personal interview.

The fisheries of Alaska are conducted primarily by large operators. Sworn statements are required from these operators concerning their operations. These are collected and compiled by the Alaska division of this bureau. Bulletins containing statistics for each district are released following the survey.

Atlantic mackerel fishery.—Complete statistics on the catch by the Atlantic mackerel fleet are obtained by combining the figures of those landed at Boston and Gloucester, Mass., and Portland, Me., with those obtained by agents who in recent years have been stationed at other Atlantic ports where mackerel are landed. These agents obtain data on each fare of mackerel landed, similar to the data obtained on the landings by fishing vessels at the three New England ports. Complete statistics of this fishery appear only in the annual reports of this division, although the landings at the principal New England ports appear in the monthly and annual bulletins published for those ports.

Pacific halibut fishery.—Statistics of the Pacific halibut fishery are obtained by the bureau's agent in Seattle, aided by bureau representatives in Alaska and American consuls in British Columbia. The fleet classification has been arbitrarily applied by including in the "Washington fleet" all vessels that land more than half of their catch in that State. All other American vessels of the halibut fleet are included in the Alaska fleet. Monthly and annual statistical bulletins are available on this fishery, being published along with the statistics of the landings of fishery products at Seattle, Wash.

Shad and alewife fisheries.—Due to the importance of the Hudson and Potomac Rivers in the production of shad, surveys for statistics of the catch, value of the catch, and operating units are made annually. On the Potomac River similar statistics also are obtained for the alewife fishery. The surveys are conducted by agents in a manner similar to that employed in the collection of general statistics, except that probably more fishermen are interviewed as great care is exercised to make these canvasses as accurate as possible.

The State of New York obtains statistics for the fisheries of the Hudson River that closely parallel those desired by the bureau for this fishery, which alleviates the work on this river. Both Maryland and Virginia license the shad and alewife fishermen of the Potomac River, which gives a very satisfactory list of fishermen for the agents surveying this district.

Statistics of the shad and alewife fisheries are not published separately in bulletin form, but a summary of the year's activities is published in the annual report of this division.

Fisheries of Lakes Pepin and Keokuk.—As a means of ascertaining the effect of the Keokuk Dam upon the fisheries of the upper Mississippi River, annual statistics of the fisheries of Lakes Pepin and Keokuk are obtained by personal surveys conducted by employees of the bureau at the Fairport (Iowa) biological station. Their methods are like those employed in the general surveys. The statistics are not published in bulletin form, but summaries of production appear in the annual reports of this division.

Fisheries of the Mississippi River.—Statistics of that portion of the Mississippi River lying between Lakes Keokuk and Pepin were obtained for the year 1929 for the first time since 1922. These data are collected by representatives of the bureau's biological station at Fairport, Iowa, and the fish-cultural station at La Crosse, Wis. Statistics covering this production are not available in bulletin form but a summary appears in this report.

Statistics of the production of fresh-water mussel shells in the United States also were obtained for the year 1929 for the first time since 1922. These data are collected by questionnaire and personal survey. A summary of the production is published in this report.

Fisheries of Lake Okeechobee.—Statistics of the fisheries for Lake Okeechobee were obtained for the first time in 1927 as a part of the general statistical canvass of the Gulf States.

Landings at certain important United States ports.—Statistics of the landings at the principal New England ports—Boston and Gloucester, Mass., and Portland, Me.—are similarly obtained. An agent is permanently stationed at each of these ports. His duties include the obtaining of statistics on the quantity of fish landed each day by each fishing vessel, the value of such fish landed, information concerning the date of departure and arrival of the vessel, and also a list of the grounds from which the fish were taken and the gear used in their capture. These statistics are forwarded to the bureau, where compilations are made. Monthly statistical bulletins are issued for these landings as well as annual bulletins summarizing the year's activities.

Statistics of the landings of fish at Seattle, Wash., are collected by the bureau's agent at that place. Landings are classified as those made by American fishing vessels and those received by Seattle wholesale dealers. The landings credited to American fishing vessels are made by vessels operating distinctly as primary fishing units, usually in the offshore fisheries, while those credited as received by wholesale dealers are usually products of the shore fisheries collected mainly from points in Puget Sound and do not include fish received from Alaska or Canada, or landings made by the halibut fleet. Monthly statistical bulletins are issued for these landings as well as annual bulletins summarizing the year's activities.

Statistics of the combined landings of fish at New York City and Groton, Conn., are obtained by J. H. Matthews, executive secretary of the Middle Atlantic Fisheries Association. Statements of these landings are forwarded to the bureau, where they are compiled. These statistics have not included the value of the catch. Monthly bulletins including these data are not issued; however, a summary is published herewith.

Statistics of the fishery products handled at the municipal wharf, Washington, D. C., are reported to the bureau daily by agents of the city health department. These are compiled on an annual basis. They are not published in bulletin form, but a summary of the year's activities is published in the annual report of this division.

Canned fishery products and by-products.—Beginning in 1921, the bureau has made annual surveys for statistics of the canned fishery products and by-products industries. These are begun the first week in January of each year for statistics of the production in the preceding year. The surveys occupy usually 6 to 9 weeks' time. During this period agents visit each plant in the United States where there is a production of canned fishery products or by-products. They obtain statistics of the production and value of the production for each commodity. In rare instances, where plants are not easily reached by regular transportation facilities, returns are obtained by mail.

Statistics on the production of fresh-water mussel shell products, which include pearl buttons, crushed shell for poultry feed, lime, cut shells, stucco, and colored shell chips used for decorative purposes, were included in this survey for the first time in the data for 1929.

The value shown for canned products constitutes the gross amount received by the packer at the production point, no deductions being made for commissions or expenses.

Statistics of the canned fishery products and by-products produced in Alaska are received on the same sworn statements that include statistics of the general fisheries. An annual statistical bulletin is issued on this trade.

Packaged-fish trade.—Complete statistics of the annual production and value of fish packaged in the United States are obtained as a part of the survey for statistics of the canned fishery products and by-products industries. These statistics are published in bulletin form annually.

Cold-storage holdings of fish.—An arrangement has been made with the Bureau of Agricultural Economics, Department of Agriculture, whereby statistics of the cold-storage holdings of the various species of fish, by sections of the United States, are furnished to this bureau monthly. Included with statistics of the holdings is a statement of the quantity of the various species of fish frozen and also the holdings of cured fish. Bulletins showing these statistics are issued monthly as well as annually summarizing the year's activities.

Sponge market, Tarpon Springs.—A large proportion of the total output of sponges in Florida is handled through the sponge exchange at Tarpon Springs. In view of this, the bureau has arranged with a representative of the exchange to furnish statistics of the quantity and value of the sponges, by variety classification, handled through it annually. Statistics of the quantity of sponges handled through the exchange are not published in bulletin form, but a summary of the year's activities is published in the annual reports of this division.

Foreign fishery trade.—Statistics on the foreign fishery trade are obtained from compilations made by the Bureau of Foreign and Domestic Commerce. Statistics of all known fishery products imported or exported are assembled in one table and published annually in the report of this division.

STATISTICAL PRACTICES

Practices followed in the collection and tabulation of statistics are explained below:

Days absent.—In computing "days absent" for vessels landing fares at the various ports, the day of departure and the day of arrival are included; thus, a vessel leaving port on the 8th of the month and returning on the 15th of the month will be shown as being absent eight days.

Operating units.—Operating units as referred to in this document include persons engaged and fishing craft and gear employed.

Vessels.—The term "vessels" refers to craft having a capacity of 5 net tons or greater.

Percentages.—Percentages are usually shown as whole numbers. Fractions of per cents are dropped if less than five-tenths, and the percentage is raised to the next higher integer if the fraction is greater than five-tenths. If the fraction is exactly five-tenths, the integer is raised or lowered to make it an even number.

Converting.—Many of the figures shown in the statistical tables published herewith have been reduced to thousands of pounds or dollars. In making these conversions the largest number from which a group of items is computed is raised or lowered to the nearest thousands place. If the number ends in an even 500, the thousands integer is raised or lowered to make it an even number. The individual items are changed to conform to the total thus obtained.

Conversion factors.—The principal conversion factors that have been used in this report follow:

Alewives	1 weighs about 3/5 of 1 pound.
Clams, hard	1 bushel equals about 8 pounds of meat.
Clams, soft	1 bushel equals about 10 pounds of meat.
Cod, large, salted	To convert to fresh-gutted weight multiply by 1.90.
Cod, market, salted	To convert to fresh-gutted weight multiply by 1.94.
Cod, scrod, salted	To convert to fresh-gutted weight multiply by 1.98.
Crabs, blue (hard and soft)	1 weighs about 1/3 of 1 pound.
Cusk, salted	To convert to fresh-gutted weight multiply by 1.90.
Haddock, large, salted	To convert to fresh-gutted weight multiply by 2.06.
Haddock, scrod, salted	To convert to fresh-gutted weight multiply by 2.10.
Hake, large, salted	To convert to fresh-gutted weight multiply by 1.90.
Hake, small, salted	To convert to fresh-gutted weight multiply by 1.98.
Halibut, salted	To convert to fresh-gutted weight multiply by 2.
Herring, salted	To convert to fresh-gutted weight multiply by 1.50.
Mackerel, salted	To convert to fresh-gutted weight multiply by 1.35.
Menhaden	1 weighs about 3/5 of 1 pound.
Oysters, market and seed	1 bushel equals about 7 pounds of meat.
Oil (east coast)	1 gallon weighs about 7.5 pounds.
Oil (west coast)	1 gallon weighs about 7.74 pounds.
Pollock, salted	To convert to fresh-gutted weight multiply by 1.90.
Scallops	1 bushel equals about 6 pounds of meat.
Sponges, dried (Florida):	
Large wool	1 weighs about 2½ pounds.
Small wool	1 weighs about 1 pound.
Glove	1 weighs about 1½ pounds.
Grass	1 weighs about 2½ pounds.
Wire	1 weighs about 1½ pounds.
Yellow	1 weighs about 1½ pounds.

Persons wishing to obtain copies of all statistical bulletins issued by the bureau should request to be put on the bureau's mailing list No. 132 for general statistical bulletins and No. 135 for the monthly cold-storage reports.

PROGRESS IN BIOLOGICAL INQUIRIES, 1929 [1]

By Elmer Higgins

Chief, Division of Scientific Inquiry

(With the collaboration of investigators)

CONTENTS

[1] Appendix XV to the Report of the U. S. Commissioner of Fisheries for 1930. B. F. Doc. 1096.

INTRODUCTION

Research activities of the staff of the division of scientific inquiry during 1929 have been directed toward a solution of the original problems facing the Bureau of Fisheries—the estimating of the present supply of fish, the detecting of overfishing, and encouraging the upbuilding of the fisheries. In addition to activities pertaining primarily to the great commercial sea fisheries, important inquiries have been conducted in the field of aquiculture, both as relates to the propagation and culture of inland food and game fishes and to the methods of farming oysters and other mollusks.

It may not be apparent at once that all of the bureau's investigations of the sea fisheries bear directly upon the problems of determining the supply, of gaging or foretelling its fluctuations in abundance, or in determining methods of so regulating exploitation of these resources that a maximum yield of products valuable as food or as raw material for various industries may be maintained. Perhaps the most direct approach to the question of total abundance and variations in annual supply is found in the investigation of the mackerel fisheries of the North Atlantic, where marked progress has been made during the year in analyzing the components of the commercial catch and in determining the relative abundance of the various year classes of mackerel population. Such investigations show great promise of practical application in the foretelling of the abundance of future runs of fish and thus supplying information of direct economic value to the fishing fleet and related shore industries, at the same time making it possible to guard against depletion. Similar methods of study are being applied to the supplies of weakfish, whiting, scup, butterfish, flounders, etc., that support the extensive shore fisheries of the Atlantic coast from southern New England to the Chesapeake Bay.

Corresponding to these direct studies of supply on the Atlantic coast are the investigations of the great salmon fisheries of Alaska. Here scientific studies are providing information that is rapidly bringing this important source of food within complete control. This promises the ultimate restoration of former abundance and assures the perpetuation of the supply.

Of less direct application, but of equal importance to an understanding of the fisheries, are such studies as the tracing of the course of development from egg to adult in these same species of food fishes and in the many related or competing species preying upon commercial forms or furnishing their food. Of still more remote application, but of even more fundamental importance, is the understanding of those factors in the environment that determine the fate of the myriads of fish eggs deposited in the ocean waters each season. Oceanographical studies recently undertaken dealing with the currents, salinities, temperatures, and other physical and chemical phenomena of the ocean waters, as well as the teeming invertebrate life therein contained, all bear ultimately upon fishery problems and may hold the key to the final understanding and control of variations in the fish supply.

In addition to these more theoretical researches studies on practical methods of fishery conservation have been conducted. For example, as a result of extensive experiments in Great Lake waters recommendations have been formulated for improving commercial fishing gear in order to avoid undue wastage of immature and undersized fish caught ordinarily along with marketable sizes. In the Pacific Northwest practical methods have been developed for screening the mouths of irrigation ditches and power-diversion canals to prevent the tremendous losses of young migrating salmon from following the downstream currents into the irrigation ditches, or protecting them from injury and destruction by power-house equipment. The prevention of such waste is a positive means of conservation, and progress in these lines is most encouraging.

The work of the investigators in aquiculture has continued to yield practical and valuable results. As a culmination of several years' experiments on trout culture, Document 1061, Care and Diseases of Trout, appeared late in the year. This publication, although based on painstaking scientific work, presents the information of value to the trout culturist in such simple and practical terms that it has received much enthusiastic praise from fish culturists at home and abroad. Progress has also been made in increasing the production of the warm-water pond fishes, such as largemouth bass and crappie, and in understanding the factors regulating the production of fish food in pond areas.

Mollusks, being stationary, are peculiarly adapted to successful farming, and marked improvements have been made by the bureau's investigators in oyster-cultural methods. These are rapidly being adopted by the oyster producers of both coasts. In fresh-water mussel culture numerous difficulties involved in the method of artificial propagation described in the previous report have been solved, and methods of large-scale production are being developed. As a result of these advances the old method of mussel propagation by the inoculation of stranded fishes in the Mississippi River has been abandoned as being of doubtful efficacy. The prospects for early rehabilitation of the mussel fishery in the upper Mississippi River, however, are uncertain because of the increasing menace of pollution. Plans are under way to give to the problems of river pollution during the coming year the attention that the gravity of the situation warrants.

Investigators of the division of scientific inquiry have continued to participate in the activities of the North American Committee on Fishery Investigations, an international body formed for coordinating investigations of the fisheries of the North Atlantic coastal and high sea areas. At a meeting held October 15 and 16, 1929, at Ottawa, Canada, representatives of Canada and the United States were present and gave extensive consideration to problems of fishery investigation of the cod, haddock, mackerel, and other fishes of economic importance, as well as certain oceanographical investigations of the region having international interest. Attention was given to the possible effect on the fisheries of the proposed damming of Passamaquoddy Bay, a subcommittee being appointed to examine the conditions of that area, to consider the plans of the company proposing to develop hydroelectric power, to study all available information bearing on the predictable effects of the project on the fisheries of the region, and to report findings to the two Governments. A meeting of this committee was held December 12, 1929. A report was rendered and recommendations offered for a more thorough investigation of the oceanographic and biological conditions affecting the fishery, to be conducted jointly by the two Governments.

During the year 1929, 17 scientific or administrative reports were published under the supervision of the division and as a result of investigations of its staff. The list of papers follows:

Scallop industry of North Carolina. By James S. Gutsell. Appendix V, Report of Commissioner for 1928. 8°, 27 pp., 11 illus. Document No. 1043.

Progress in Biological Inquiries, 1927. By Elmer Higgins. Appendix VI, Report of Commissioner for 1928. 8°, 51 pp. Document No. 1044.

Natural history and conservation of redfish and other commercial Sciaenids on Texas coast. By John C. Pearson. Bulletin, Vol. XLIV, 1928. Royal 8°, 88 pp., 44 illus. Document No. 1046.

Experiments in marking young chinook salmon on Columbia River, 1916–1927. By Willis H. Rich and Harlan B. Holmes. Bulletin, Vol. XLIV, 1928, Royal 8°, 52 pp., 24 illus. Document No. 1047.

Coregonid fishes of Great Lakes. By Walter Koelz. Bulletin, Vol. XLIII, Pt. II, 1927. Royal 8°, 349 pp., 26 illus. Document No. 1048.

Shrimp fishery of southeast Alaska. By Frank W. Hynes. Appendix I, Report of Commissioner for 1929. 8°, 20 pp., 8 illus. Document No. 1052.

Life history of the lake herring (*Leucichthys artedi* le Sueur) of Lake Huron, as revealed by its scales, with critique of scale method. By John Van Oosten. Bulletin, Vol. XLIV, 1928. Royal 8°, 166 pp., 28 illus. Document No. 1053.

Investigation of physical conditions controlling spawning of oysters and occurrence, distribution, and setting of oyster larvæ in Milford Harbor, Conn. By Herbert F. Prytherch. Bulletin, Vol. XLIV, 1928. Royal 8°, 77 pp., 32 illus. Document No. 1054.

Check list of the fishes and fishlike vertebrates of North and Middle America north of northern boundary of Venezuela and Columbia. By David Starr Jordan, Barton Warren Evermann, and Howard Walton Clark. Report of Commissioner for 1928. Part II, 674 pp., 8°. Document No. 1055.

Salmon tagging experiments in Alaska 1927 and 1928. By Willis H. Rich and Frederick G. Morton. Bulletin, Vol. XLV, 1929. Royal 8°, 25 pp., 2 illus. Document No. 1057.

Review of weakfishes (*Cynoscion*) of Atlantic and Gulf coasts of United States, with description of a new species. By Isaac Ginsburg. Bulletin, Vol. XLV, 1929. Royal 8°, 17 pp., 7 illus. Document No. 1058.

Review of experiments on artificial culture of diamond-back terrapin. By Samuel F. Hildebrand. Bulletin, Vol. XLV, 1929. Royal 8°, 48 pp., 14 illus. Document No. 1060.

Care and diseases of trout. By H. S. Davis. Appendix 4, Report of Commissioner for 1929. 8°, 55 pp., 6 illus. Document No. 1061.

Keokuk Dam and fisheries of upper Mississippi River. By Robert E. Coker. Bulletin, Vol. XLV, 1929. Royal 8°, 55 pp., 10 illus. Document No. 1063.

Oyster industry of Pacific coast of United States. By Paul S. Galtsoff. Appendix 8, Report of Commissioner for 1929. 8°, 36 pp., 13 illus. Document No. 1066.

Condition of razor-clam fishery of Washington. By H. C. McMillin. 8°, 7 pp., 2 illus. Economic Circular No. 64.

Oyster bottoms of North Carolina (with bibliography). By Paul S. Galtsoff and H. R. Seiwell. 8°, 11 pp. Economic Circular No. 66.

In addition to these, the following papers were published in other than the bureau's series:

Influence of certain water conditions, especially dissolved gases, on trout. By J. S. Gutsell. Ecology, Vol. X, No. 1, January, 1929, pp. 77–96.

Notes on northwest Atlantic sharks and skates, by Henry B. Bigelow and William C. Schroeder. Bulletin, Museum of Comparative Zoology, Vol. LXVIII, No. 5, September, 1928, pp. 239–251, Cambridge.

A rare bramid fish (*Taractes princeps* Johnson) in the northwestern Atlantic. By Henry B. Bigelow and William C. Schroeder. Bulletin, Museum of Comparative Zoology, Vol. LXIX, No. 2, February 1929, pp. 41–50, Cambridge.

A preliminary report on the growth of the rock bass, *Ambloplites rupestris* (Rafinesque), in two lakes of northern Wisconsin. By Stillman Wright. Transactions, Wisconsin Academy of Sciences, Arts, and Letters, Vol. XXIV, November, 1929, pp. 581–595.

As in previous years, the division has again been fortunate in receiving whole-hearted and generous cooperation from various States and private agencies, thus materially increasing its investigations in both extent and effectiveness. Such cooperation, which is gratefully acknowledged, is in most cases mentioned in connection with the various investigations in the following pages. The following progress reports covering the more important investigations conducted by the division during the calendar year 1929 were prepared in the main by the investigators in charge of the various projects.

NORTH AND MIDDLE ATLANTIC FISHERY INVESTIGATIONS

Some of the country's most productive fisheries are prosecuted in the waters along the Atlantic seaboard from Maine to the Virginia capes. Exclusive of shellfish, the annual harvest gives a gross return of nearly $24,000,000 to the commercial fishermen.

Initial steps in studies of marine fisheries are to learn the life histories of the fishes themselves, their movements, the specific peculiarities in birth rate and mortality that regulate their abundance, but investigations soon reach the point where further understanding requires intimate knowledge of the significant physical and biological conditions in the sea.

OCEANOGRAPHIC STUDIES

A consolidation of the several investigating staffs in this area has made it possible to initiate in a small way an oceanographic program in accompaniment with the various fishery investigations. The cooperation of the Museum of Comparative Zoology at Harvard University in providing laboratory and library facilities for the major portion of the staff engaged in these studies has been of prime importance in making this arrangement feasible, and the advice of Dr. Henry B. Bigelow, of the museum staff at the Museum of Comparative Zoology, has been largely responsible for the planning of the oceanographic projects.

The bulk of oceanographic observations were made during five cruises of the *Albatross II* in connection with the mackerel investigations, the principal object being to estimate the success of mackerel spawning. Two other cruises were made in connection with the cod investigations. The principal object of the trip in February and March, was to determine conditions in the wintering grounds of the codfish off New York and New Jersey. A few observations also resulted from a cod-tagging trip to Nantucket Shoals in June. (See Table 1.) As a result, we have temperature and salinity surveys of the waters overlying the continental shelf between Cape Cod and North Carolina for February, April, and July; zooplankton surveys of surface and deep levels for April, May-June, and July; and surface phytoplankton surveys for the same months. In addition, there are two series of collections for the study of diurnal vertical migrations of zooplankton.

The fish eggs and larvæ of these cruises have been partially examined, and the zooplankton of all but the last cruise has been analyzed in a preliminary way. On January 1, the data on physical oceanography still awaited analysis.

On the February cruise a series of 370 drift bottles were released on lines bearing 163° 30′ true from Montauk Point and 130° 30′ true from New York. The same sets were repeated on the July cruise. Returns from these series have been disappointingly few. Several were picked up on the beaches along the North Carolina coast and a few were returned from southern New England points. Not enough are available to warrant conclusions as to currents in the region.

TABLE 1.—*Summary of oceanographical work done in conjunction with cod and mackerel investigations, 1929*

Dat	Station numbers [1]	General locality	Number of stations occupied	Temperature and salinity observations		Collections made				
				Serials surface to bottom	Surface only	Zooplankton, surface	Phytoplankton, surface	Zooplankton, intermediate levels	Zooplankton, deep levels	Other
Feb. 24 to Mar. 5.	20384–20420	Cape Ann, Mass., to Cape Henry, Va., and out to the continental slope.	37	37	----	9	8	----	8	Young fish trawl 3 hauls.
Apr. 14 to May 18.	20421–20456	Montauk Point, Long Island, N. Y., to Bodie Island Light, N. C., and out to continental slope.	36	35	1	33	33	5	33	
May 10 to 18	20457–20498	No Mans Land, Mass., to Bodie Island Light, N. C., and out to the continental slope.	42	1	41	41	40	----	33	Vertical distribution series at 1 station,[2] 5 volumetric surface hauls.[3]
May 28 to June 5.	20499–20542	Cape Cod Bay, Mass., to Cape Henry, Va., and out to the continental slope.	44	----	44	21	44	12	42	29 volumetric surface hauls.[3]
June 12 and 13	20543–20547	Nantucket Shoals	5	[4] 1	----	----	----	----	----	4 hauls, young fish trawl.
July 11	20548–20551	Cape Cod Bay and offing of Cape Cod.	4	4	----	4	4	----	4	
July 13 to Aug. 1	20552–20959	Cape Cod Bay to Cape Henry, Va., and out to the continental slope.	47	47	----	30	45	3	46	Vertical distribution series at 1 station; [2] 30 volumetric surface hauls.[3]

[1] Albatross series.
[2] Station was occupied 24 hours, and 4 series of horizontal zooplankton tows were taken at 5 levels.
[3] Experimental horizontal zooplankton hauls with current meter registering amount of water passing through mouth of net.
[4] Temperatures only.

COD, HADDOCK, AND POLLOCK

The study of the life history of the cod, which has been in progress since 1923, was continued during 1929 by William C. Schroeder.

The field work during the past year included:

(*a*) The tagging of cod off the coast of southern New Jersey from time to time within the period from January 1 to April 8.

(*b*) A hydrographic cruise made by the *Albatross II* from southern Massachusetts to Cape Charles, Va., February 24 to March 7.

On this trip water samples and temperatures were obtained at all 37 stations that were made; plankton hauls were made at 8 and an otter trawl was used at 3 stations. Drift bottles were set out along 2 lines totaling 180 miles, one of which was off Montauk Point and the other off New York City.

(c) A cod-tagging cruise made June 9 to 15, by the *Albatross II*, to Nantucket Shoals.

FIGURE 1.—Oceanographic work aboard the U. S. F. S. *Albatross II*. One of a series of Greene-Bigelow water bottles with a sample of sea water from a known depth is being brought aboard.

(d) A cruise made from September 17 to 28 on a commercial otter trawler to the northeast part of Georges Bank, where specimens and data were collected on the cod, haddock, and other fishes.

TABLE 2.—*A summary of the number of fish tagged from 1923 to 1929*

BY SPECIES

	1923–1928	1929	Total
Cod tagged	39,496	1,169	40,665
Pollock tagged	4,799	13	4,812
Haddock tagged	10,620	134	10,754
Total	54,915	1,316	56,231

BY LOCALITIES

	1923–1928	1929	Total
Browns Bank and vicinity	2,113		2,113
Georges Bank	2,002		2,002
New Hampshire and Maine	19,581		19,581
Massachusetts, north of Cape Cod	645		645
Massachusetts, south of Cape Cod	29,857	848	30,705
New York and New Jersey	717	468	1,185
Total	54,915	1,316	56,231

TABLE 3.—*A summary of the number of cod, pollock, and haddock tagged and recaptured during the years 1923–1929, inclusive*

	Tagged	Recaptured	Per cent
Cod	40, 665	2, 667	6. 6
Pollock	4, 812	101	2. 1
Haddock	10, 754	189	1. 8
Total	56, 231	2, 957	

Data on the haddock and pollock were collected incidental to the cod-tagging operations. So few of the tagged haddock and pollock have been recaptured that very little can be said specifically concerning their migrations. In general it appears that some adult

FIGURE 2.—Tagging a codfish to study its migrations

haddock and pollock may remain for a year or more in one immediate locality, but both species seem more irregular in their movements than the cod. Apparently a fair proportion of the haddock along the coast of Maine immigrate to the region southeast of Cape Cod (South Channel). Neither the haddock nor the pollock migrate westward from Nantucket Shoals in the fall in such bodies as do the cod, for only an occasional one of either species reaches New Jersey.

MACKEREL

The year 1929 was of unusual interest in the mackerel investigations. For the past four years the mackerel population had consisted almost entirely of the brood hatched in 1923, and since their peak year in 1926 they had been providing definitely declining catches. The paramount question was whether a new brood would materialize to augment the mackerel stock before the 1923 brood was so severely reduced that years of scarcity would ensue. Our 1928 data indicated the survival of a moderate number of mackerel of the 1927 brood but not enough to give assurance of offsetting the decline in the much older 1923 brood.

As was expected, the 1929 season witnessed a continued decline in the abundance of mackerel of the 1923 brood. From a catch of about 24,000,000[2] fish in 1926, these declined to a catch of about 12,000,000 fish in 1929.

The 1927 brood contributed only 2,000,000 fish. Had the year's production depended on these two broods, the fishery would have suffered a severe decline. But this was prevented by the appearance of an extraordinarily large brood resulting from the 1928 spawning season. So plentiful were mackerel of this brood that even though undesirable commercially because of their small size (about ¾-pound each), they nevertheless made up the bulk of catches during the summer and early fall. Their yield totalled more than 21,000,000 mackerel—enough fish to raise the total catch to 44,000,000 pounds, which was just under that of the peak year, 1926, and constituted a 40 per cent increase over 1928.

The advent of this apparently enormous brood will undoubtedy have profound effects on the abundance of fish, lasting through the next several years. It is the first brood that this investigation has witnessed from its beginning, and the observation of its changes in abundance is almost certain to constitute a distinct contribution to our understanding of the changes in abundance in this fishery. As early as 1928, tentative predictions on the abundance of mackerel were made in advance of the season. The forecasts thus far have proved essentially correct. But the limitations of our knowledge have confined these attempts to general terms and provisional qualifications.

The attainment of the above-indicated understanding of mackerel fluctuations has resulted from the continuation of the biostatistical study of the fishery carried on jointly by the division of fishery industries and scientific inquiry since 1925. The 1929 work continued under the direction of Oscar E. Sette, assisted by Edward W. Bailey. Most of the observations of mackerel at landing ports were made by Frank E. Firth. Robert A. Goffin collected valuable information on the fishery in the vicinity of Woods Hole and, during a short period early in the season, on the landings of the deep-sea fleet at Cape May, N. J. Field assistants, engaged primarily in the collection of data on the pound-net fishery of the middle Atlantic region, also collected considerable data on the lengths of mackerel taken on their stations. Altogether, information was secured as to date, locality, quantity, and other items on 1,430 out of a total of 2,876 fares landed by the offshore fleet. Samples from 971 fares were measured. These, together with 2,734 mackerel measured by pound-net observers, make a total of over 37,000 length measurements for the season. Scale samples were taken from 615 mackerel.

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[2] The numbers of fish were calculated from: (1) The weight of the catch, which is a matter of statistical record; (2) the length composition of the catch, which resulted from our market measurements; and (3) the relation of weight to length, which was computed from weight-length data on more than 2,000 mackerel.

An important new series of observations was initiated in 1929 when blank books were furnished the captains of mackerel vessels in which to record their daily fishing activities and observations on the mackerel at sea. Of the 68 distributed we have already received 18 complete daily records and 22 extending over part of the season. The splendid cooperation of the vessel captains in keeping these detailed records under the rigorous conditions at sea has the bureau's fullest appreciation. These logs have been and will continue to be exceedingly useful in supplementing our data on the occurrence of schools of mackerel observed but not caught, the presence of young mackerel below commercial sizes, and the shifting of schools from one ground to another. In addition they will be of particular value in estimating fishing intensity, for from them we may secure much needed information on periods of enforced idleness due to stormy weather and other modifications of the activities of the fleet.

The investigation also included the collection and analysis of statistics with regard to the total mackerel catch and the size of the mackerel fleet, together with other data pertinent to an estimate of the intensity of fishing. These are to be treated more fully in the report of the division of fishery industries.

One of the most obvious problems arising from the phenomenon of age dominance which has been observed in the mackerel fishery is to determine the probable causes for success in some years and failure in many others. To provide information on this phase of the problem, oceanographic cruises to the mackerel spawning grounds were made during the 1929 season. Four trips were made from April to July in the waters of the continental shelf between Cape Cod and North Carolina, and additional stations were occupied at a limited number of locations in the offing of Cape Cod and Massachusetts Bay. Altogether, 288 stations were occupied during the season.

The primary object was to determine the abundance of mackerel eggs spawned in various areas and the relative success of the hatching and survival of larvæ. In addition to the townet collections made for this purpose, the usual series of temperatures and salinities at various levels were taken at most of the stations on the April and July cruises.

Judging from the examination of only part of the material collected on these cruises, mackerel eggs were approximately as abundant in 1929 as in the two previous years—the only years of which we have any record. An abundance of newly hatched larvæ in the hauls of the early June trip indicates a fairly successful hatch; but the scarcity of larger larvæ in July would make it appear that the 1929 brood was rather less successful in surviving through its early stages than was the 1928 brood, of which some very good catches of large larvæ were taken at certain stations off southern New England in July of 1928.

NEW ENGLAND SMELT

One section of the second report concerning the smelt, by Dr. William C. Kendall, was completed early in the year. This section comprises a synopsis of the classification of the smelts as presented in the literature and a discussion of the relationship of the nominal species so far as indicated by available data. A second section of same report comprises a consideration of the salt water and fresh water smelts of the east coast of North America. This was begun long before the section just referred to was found necessary for a proper consideration of the smelts of this region. The latter study and the facts revealed by more recently acquired information, necessitated a revision of the entire manuscript. This has been done, but while the problems concerning these smelts can not be regarded as wholly solved, it is believed that the situation is made clearer by the manner of treatment. However, the highly interesting and very important question of the relationship of the " large " and " small " forms of smelts of some lakes has been complicated by the receipt from John W. Titcomb, superintendent of the board of fisheries and game of Connecticut, of two similar size classes of marine smelts from Connecticut taken during the breeding runs. The larger form appears to be of about the same sizes as observed in Maine, but those of the smaller class are smaller than any adult marine smelt that have come under observation.

This year the two brooks near Freeport, Me., which have been under observation by Doctor Kendall during the breeding season of smelts since 1924, were watched as in previous years, but not quite as constantly. Quite surely, however, not many smelts were caught during the season, as judged by report and observation. From April 4 to May 4, both inclusive, 109 fish constitute the positive records. No fish were observed after May 4. The fact that the weather was generally bad may have affected the runs, but usually in the past not even a snowstorm would prevent a run. It would appear on the whole that the prediction that the runs would be poor this year was fulfilled. This prediction was based on the facts that the runs of breeding smelts to a great extent are composed of 2-year old fish, as a rule, and that scarcely any smelts appeared in the brooks in 1927. Furthermore, the majority of the fish examined this spring were more than 2 years old.

There is evidently a pronounced decline of the smelt fishery, particularly manifested in the Casco Bay region, as evinced by reports from commercial fishermen, landings in the wholesale market of Portland, and observations in the breeding season of smelts.

There are several factors which contribute to this decline, two of which are particularly effective—one is the destruction of smelts while ascending brooks to spawn and the other is the tremendous destruction of immature smelts by seining operations during the open season.

SHORE FISHERY OF THE MIDDLE ATLANTIC STATES

An investigation of the more important species, including squeteague, bluefish, sea bass, scup, butterfish, summer flounders, whiting, and croakers, has been conducted since July, 1927, under the direction of R. A. Nesbit.

The most serious handicap to acquiring a knowledge of the status of this fishery is the lack of adequate statistical records. In 1928 the bureau provided pound-net fishermen with forms for keeping detailed daily records of their catches. These were continued in 1929, and the number of fishermen voluntarily cooperating increased to a gratifying extent.

In order to follow quantitative and qualitative fluctuations in the yield, the sampling of commercial catches begun in 1928 was continued and extended in 1929. More than 100,000 fish of several species were measured and over 6,000 scale samples taken at 8 field bases located at Montauk and Fire Island, N. Y.; Long Branch, Seaside Park, Beach Haven, and Wildwood, N. J.; Hampton and Exmore, Va.

Excellent progress was made in the analysis of biological data concerning squeteague and scup. With regard to the squeteague, it is probable that the general increase in the 1929 catch over 1928 is due to the entrance of large numbers of the 1926 brood. This dominance may be expected to make itself felt for several years.

In order to trace migrations 1,800 squeteague were tagged at Wildwood, N. J., during June, 1929. A few local recaptures were made, all within a few weeks of tagging. Little hope is entertained that additional recaptures will be reported.

Data on the scup also indicate the effects of dominance. The 1927 brood, although too small to figure in the commercial catch of 1928, was observed in unusually large numbers in the pound nets, and reappeared as expected in 1929, increasing the average catch per trap nearly fivefold over the 1928 average.

This result is the more remarkable because the abundant 1927 brood was spawned in a season of abnormally low yield—that is, relatively very few adults—indicating not only an unusual resistance to fishery strain but also that the number of survivors is to a large extent independent of the number of spawning adults.

In order to supplement the general oceanographic program discussed above, two surveys of inshore waters were carried out in 1929. A survey of Delaware Bay, under the direction of Prof. A. E. Parr, was undertaken in cooperation with the Bingham Oceanographic Collection. From the middle of May to the end of September, three cruises were made each week, with additional cruises at longer intervals during October. Several stations were occupied on each cruise, and at each station in addition to plankton or juvenile fish collections, temperature, salinity, and hydrogen-ion concentration were noted. A series of drift bottles was released in order to determine the effect of currents on migrations of fish eggs and larvæ. At the beginning of the season most of the collections were made with townets. Later, Peterson trawls were used for the capture of juvenile fishes. Spawning grounds of several of the species frequenting this region were located, and dates of maximum spawning effort observed.

The large collection of juvenile fishes have contributed much of value to our knowledge of the rates of growth of squeteague, scup, and sea bass during their first year of life. This provides a sound foundation for determination of the age of older fish.

A similar survey was carried out in Chesapeake Bay by J. C. Pearson. His collection, derived from about 300 townet hauls, includes larval and postlarval stages of 43 species as well as eggs and juveniles.

Data collected in these surveys are being analyzed in the Peabody Museum, Yale University. The kindness of the museum in providing laboratory and library facilities is gratefully acknowledged.

INDEPENDENT ACTIVITIES AT THE FISHERIES BIOLOGICAL LABORATORY, WOODS HOLE, MASS.

In accordance with the bureau's long established policy of encouraging independent research in marine biology and related subjects, the facilities of the laboratories at Woods Hole, Mass., were made available to a number of investigators from various educational institutions. Personnel so accommodated at Woods Hole included: Dr. Edwin Linton, University of Pennsylvania, studying helminth parasites of fishes; Dr. C. J. Connolly, Catholic University, color reactions of crabs; Albert J. Dalton, College of the City of New York, embryonic development of fishes; Paul S. Conger, United States National Muesum, marine diatoms; R. E. Bowen, Harvard University, the eighth nerve of fishes; Kendall W. Foster, Harvard University, coloration in fundulus; Dr. John C. Hemmeter, Johns Hopkins University, isles of Langerhans in Lophius; M. E. Holcomb, Princeton University, luminous marine bacteria; Dr. N. A. Cobb, Department of Agriculture, nematodes; Leon C. Chesley, Duke University, enzymes in fishes; W. E. Bullinton, of Randolph Macon College, spiraling in the ciliate Frontonia; Dr. F. G. Hall, Duke University, physiology of fishes; and Dr. I. E. Gray, Tulane University, physiology of fishes.

MacMILLAN LABRADOR AND BAFFIN LAND EXPEDITION

At the request of Commander Donald B. MacMillan, Doctor Kendall was detailed to accompany the expedition to Baffin Land for the purpose of studying the geographical distribution of the fishes, particularly salmon and trout (chars). A preliminary report appears in Fisheries Service Bulletin, No. 174, November 1, 1929.

Not much was added to what was already known concerning the distribution of the salmon. There is no special salmon fishery of much importance north of latitude 55°. Those caught farther north appear to be incidental to the trap fishery for cod. According to report occasionally a few salmon are caught as far north as Ryans Bay.

Northern chars, called "sea trout" are abundant all along the Labrador coast and were found in two places in Frobisher Bay, Baffin Land.

The brook trout (*Salvelinus fontinalis*) also occurs as "sea trout" in southern Labrador and probably as far north as the species occurs in coastal fresh waters. The most northern point of occurrence of this trout was in the tidal portion of a stream flowing into Nain Bay. Young fish of both species were found at low tide between tide limits at several places in Labrador. Some brooks would contain only one or the other of the two forms. A small lake or pond at Nain, so far as could be ascertained, contained only young or dwarfs of the sea trout type. The males were highly colored like adults. The outlet of the pond contained only the *fontinalis* form, some of which were 8 or 9 inches long. It is difficult to conceive how these particular waters were populated, for the foot of the outlet is obstructed by a waterfall so formidable that it seems hardly possible that trout could surmount it and there is no inlet, though possibly in some seasons there may be another outlet from the head of the pond which would admit fish from another stream which flows into the harbor at Nain.

The most abundant of shore fishes in Labrador were the rock cod (*Gadus ogak*) and sculpins (*Ancanthocottus grœnlandicus*).

The rock cod is of inferior quality, quickly softening after death, and then difficult to clean. However, when freshly caught and soon cooked it is by no means unpalatable.

The common cod is abundant in deeper water.

The "fresh water cod" of Labrador was authoritatively found to be the lake trout (*Cristivomer namaycush*). Alfred C. Weed of the Field Museum, who accompanied a previous MacMillan expedition to Frobisher Bay, Baffin Land, and caught the alleged fresh-water cod in a lake there, recently advised Doctor Kendall that in the stomachs of some of the fish he found numerous sea urchins. From this fact it may be inferred that the lake is fresh only at the surface.

Besides the fishes brought back by the expedition, the collections comprise a number of marine invertebrates.

SOUTH ATLANTIC AND GULF FISHERY INVESTIGATIONS

SHORE FISHES OF NORTH CAROLINA

The collection of fish eggs and young fish, begun at Beaufort, N. C., a few years ago, was continued. During 1929 a special effort was made, by varying the methods of collecting and by sampling many localities, to complete series indicative of the various stages in the growth of as many species as possible.

To date 24 local species of fishes that have been definitely identified are represented more or less completely in the collections by series showing the various stages in development. Drawings illustrating the development have been made for all these species, and descriptions have been prepared for several. It may be stated here that the series often are not as complete as desirable and that it takes much time and perseverance to complete them. Furthermore, an effort has been made to determine the rate of growth during the first year of all the food fishes taken during the course of making collections of young fish. This work is in charge of Dr. Samuel F. Hildebrand, director of the Bureau of Fisheries laboratory at Beaufort, N. C., who is assisted by Dr. James S. Gutsell (part time) and Louella E. Cable.

TERRAPIN CULTURE

The cooperative terrapin cultural work of the North Carolina Department of Conservation and the Bureau of Fisheries begun in 1924, has been continued at the Beaufort station. On May 17, 1929, the brood of 1928, numbering 5,778 animals which had been kept in the nursery house during the winter, was turned over to the North Carolina State Fish Commission for liberation. The average length of all the animals liberated was close to 1⅓ inches. Many were 1¾ inches long, quite a few were as much as 2 inches in length, and a few 2¼ inches. However, the average length was greatly reduced by those animals that did not grow at all, of which a considerable number has been present each year since the beginning of the experiments with winter feeding.

In the fall of 1929 the new brood, amounting to 7,770 individuals, was placed in the nursery house to be fed during the winter. Several different kinds and combinations of food are employed in the feeding experiments. Last winter (1928–29) good results, from the standpoint of growth, were obtained by feeding oysters and also with a mixture of fresh fish and corn meal; shrimp bran alone was found unsatisfactory, but in combination with fresh fish it seemed to hold some promise. Most of the feeding experiments of last winter are being continued and several others have been undertaken for this winter (1929–30).

Unfortunately, during a hurricane which visited Beaufort and vicinity on October 2, 1929, the high water and strong wind combined broke the walls of two of the pounds containing slightly in excess of 1,700 adult breeding terrapins. The animals quickly made their escape, but subsequently about 150 were recovered.

A review of the experiments conducted since the beginning of the work in 1909 at the fisheries station at Beaufort, N. C., with the artificial cultural of diamond-back terrapins was prepared by Dr. Samuel F. Hildebrand, who is in charge of the terrapin cultural work of the bureau. (Doc. No. 1060.)

BAY SCALLOP

Study of the bay scallop was continued at the request of the North Carolina Department of Conservation and Development. In January J. S. Gutsell investigated a report of scallop mortality attributed to microscopic worm parasites but apparently attributable to the delayed lethal effect of water freshening.

In November, Doctor Gutsell made an investigation of the productive condition of scalloping areas. In general, adult scallops proved to be scarce. In western Bogue Sound they were more numerous than elsewhere.

ACTIVITIES OF THE FISHERIES BIOLOGICAL LABORATORY, BEAUFORT, N. C.

The work of the Beaufort (N. C.) station has been mentioned in the section of this report dealing with the investigations on young fishes, oysters, scallops, and diamond-back terrapins. Extensive repairs to the main laboratory building, begun in 1928, were continued and completed, and a residence was built. New electric wiring and fixtures were installed in all the buildings. Much of the plumbing was renewed and the system was greatly extended, including the installation of a pressure system and wash basins and water pipes in all the dormitory rooms. A small power boat was added to the floating equipment. These additions, improvements, and repairs greatly increase the usefulness and convenience of the station.

Elmer Higgins, chief of the division of inquiry, spent the summer at the station continuing the study of the life history of the mullet, begun several years ago but interrupted by other duties. Dr. Henry Federighi spent the year prior to his resignation in September at the station studying the life history of the oyster drill, and Dr. R. H. Luce worked on oyster culture during June, July, and August.

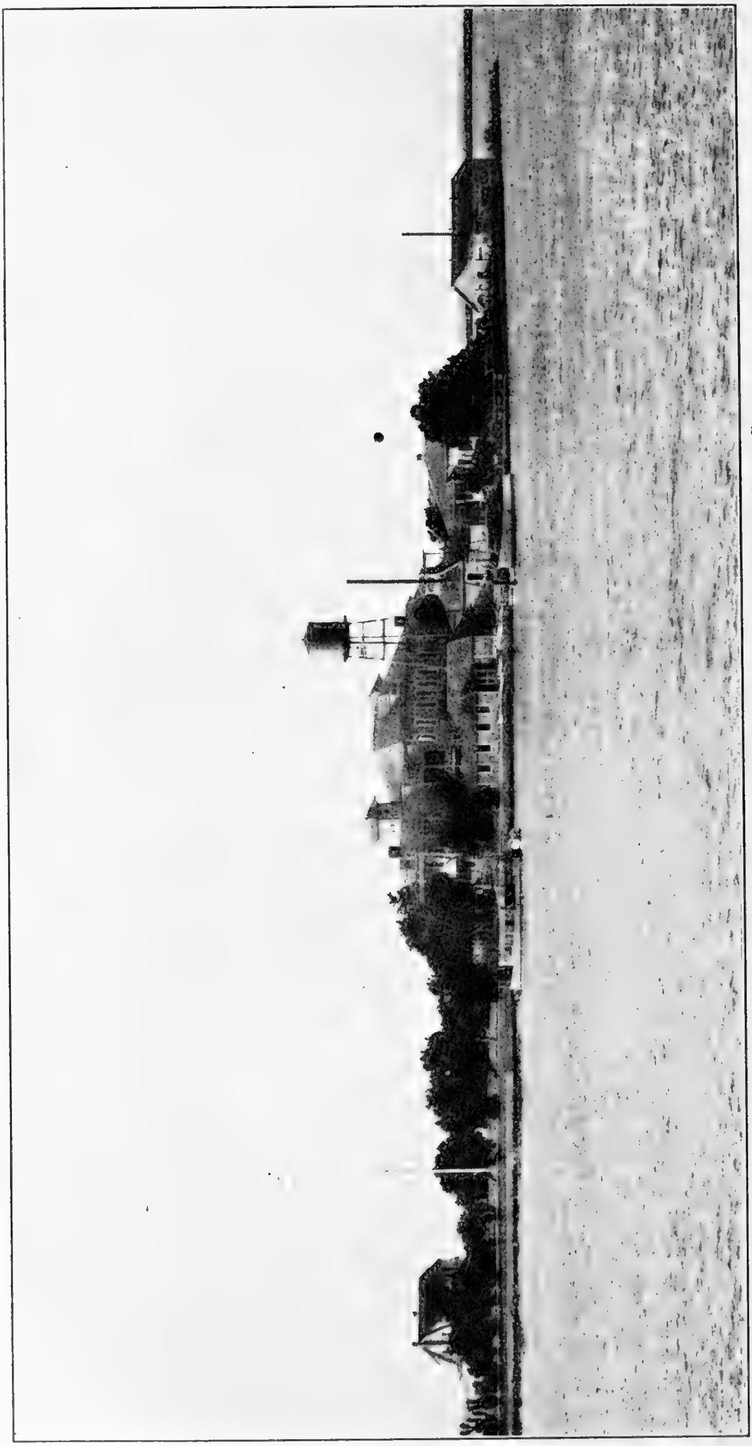

FIGURE 3.—Fisheries Biological Laboratory at Beaufort, N. C.

Independent investigators who studied at the Beaufort Biological Laboratory included the following: Dr. Bartgis McGlone, University of Pennsylvania, studies on body temperatures; Dr. W. C. George, University of North Carolina, blood of Balanoglossus; Dr. J. I. Hamaker, Randolph Macon College, distribution of calcareous sands; A. S. Rose, University of North Carolina, experiments in self-regulation of ascidians; Miss Ezda Deviney, Florida State College for Women, regeneration in ascidians; M. C. Yoder, Lenoir Rhyne College, echinoderms; E. E. Brown, public schools, Greensboro, N. C., midsummer birds; and Dr. Hoyt S. Hopkins, New York University Dental College, muscles in bivalves.

GULF COAST STUDIES

The study of the collections of fishes made at various times by different investigators on the coast of Texas was continued by Isaac Ginsburg and extended to include other places on the Gulf coast. Special attention was given to the commercially important family of Sciænidæ, with particular attention to racial studies of the common species of that family. A comparison was made of the Gulf and Atlantic populations of these species.

For some time there has been felt a need for a manual of the marine fishes of the Gulf coast, that will give descriptions of the species to facilitate their identification and such pertinent facts in their life history, habits, and economics as are known at present. A beginning was made to produce such a manual, and it is hoped to devote such time to it as may be spared from other duties until it is completed.

GREAT LAKES FISHERY INVESTIGATIONS

In 1929 work on the Great Lakes, under the direction of Dr. John Van Oosten, was confined largely to Lake Erie as was true in 1927 and 1928, although the work on experimental herring pound nets begun in the fall of 1928 on Saginaw Bay in Lake Huron and referred to in the 1928 report was continued in the spring and fall of 1929, and some data on the biology of the pike perches of Lake Ontario and of the whitefish and lake trout of Lake Michigan were collected.

COMMERCIAL FISHERIES

Virtually all the data from Lake Erie, except those on age and growth, collected in 1927 and 1928 have been compiled though not analyzed in detail. Length frequencies of all the species taken in both the experimental nets (see reports for 1927 and 1928) and the commercial nets have been made, and tables on the relative destructiveness of various-sized meshes in trap nets and gill nets have been compiled. Some of these tables served as a basis for the new regulations passed in Ohio. Much time was also devoted to a revision of the commercial fishing laws in Michigan and Indiana, and recommendations were drawn up for Wisconsin, Minnesota, and New York. All the States except Minnesota have now introduced the recommended method of collecting statistics of the daily catch together with the amount of gear employed.

The 1929 field work was devoted almost entirely to the collecting of biological and statistical data on the various species of commercial importance at Erie, Pa.; Conneaut, Lorain, Vermilion, Huron, Sandusky, and Port Clinton, Ohio. In all, some 49,819 measurements were made and scales were collected from 27,097 specimens. These data were obtained by H. J. Deason, B. H. Hill, and Dr. Stillman Wright aided by four temporary assistants, the States of Ohio and of Pennsylvania each furnishing two men.

An analysis of the blue pike, yellow pike, and sauger material of 1928 indicates that in each species the 3-year fish predominated. The 2-year group predominated in the yellow-pike material of 1927, suggesting that in this species the 1926 year class was dominant in the population. In addition to a study of the life history of these pike perches, an attempt is being made to ascertain the systematic relationship between the blue pike, the yellow pike, and what appears to be an intermediate form sometimes designated as the gray pike. For this study adult pike perches of Lakes Ontario, Erie, and Huron are being examined in addition to a large series of larval and postlarval specimens kindly loaned to us by the State of Ohio.

Analysis of the scales of the ciscoes taken in gill nets in 1927 shows the catch to be comprised almost entirely of 2 and 3 year fish, while the whitefish samples of 1927 taken in gill nets and trap nets consisted principally of 4 and 6 year fish, the 5-year group being almost entirely absent.

The work in Lake Huron on the experimental herring pound nets, referred to in the 1928 report, will not be completed until the spring of 1930 but the data collected so far show the following:

1. In the fall of 1928 no herring escaped through the larger meshes of the net for each size group was represented in approximately the same proportion in the catch of the various nets. (2 inches, 2¼ inches, and 2¾ inches.)

2. In the spring of 1929, however, some sorting seems to have taken place for the percentage of small herring in the lifts decreased progressively with each successive increase in the size of the mesh employed. (2 inches, 2½ inches, 2¾ inches, and 3 inches.)

3. The number of herring that gilled before the fish were cornered increased progressively with each increase in the size of the mesh employed.

4. Virtually no immature whitefish or yellow pickerel were gilled in the experimental nets.

The interesting inconsistency in the apparent reaction of the herring to the different-sized meshes in the fall of 1928 and in the spring of 1929 may possibly be explained on the basis that there were more small herring on the grounds in the spring of 1929 than in the fall of 1928 and, hence, the effectiveness of the nets in sorting would appear to be greatest in 1929, or that since the data were secured during the spawning season, the herring of 1928 were less aware of their surroundings because of sexual excitation and exerted less effort in escaping from the traps than those of 1929.

In addition to the work on experimental pound nets, biological data, such as length and weight measurements, sex, maturity, and scales, were collected for the important species of Saginaw Bay, especially the yellow pike, lake herring, and whitefish. Some 20,018 fish were measured and 5,176 scales were collected.

LIMNOLOGICAL STUDIES

In the years 1927 and 1928 the State of Ohio Division of Fish and Game carried on a limnological investigation of the western end of Lake Erie in connection with studies on the distribution of larval and postlarval fish. It was arranged with the Ohio organization to have Dr. Stillman Wright take charge of the limnological work for the year 1929. A laboratory was established at Put in Bay, Ohio, early in May, with two scientists in residence. During the period from June 15 to September 15, the full staff of six investigators was present, and the survey was continued until November 1 with a reduced staff.

The area covered is that west of a line drawn from Point Pelee to Cedar Point. The entire area is shallow and receives the waters from three large rivers which carry the industrial wastes from the cities of Toledo, Monroe, and Detroit. The purpose of the investigation was to make a general survey of the physical, chemical, and biological conditions with particular reference to pollution and its effect on the fish population. Chemical studies included analysis for dissolved oxygen, free and fixed carbon dioxide, and hydrogen-ion concentration. Qualitative and quantitative studies of both phytoplankton and zooplankton were made to determine the vertical, horizontal, and seasonal distribution of the various planktonts. Observations were also made of the distribution of pathogenic and natural lake bacteria and of bottom organisms. A party working independently studied the distribution of larval and postlarval fish in the same area. The data are being prepared for publication.

COOPERATIVE SURVEY OF LAKE ERIE

The cooperative survey of Lake Erie, begun in 1928, was continued in the season of 1929. To the original institutions cooperating with the Bureau of Fisheries, which included the New York State Conservation Department, Ontario Department of Game and Fisheries, Health Department of the city of Buffalo, and the Buffalo Society of Natural Sciences, was added this year the Ohio Department of Fish and Game and the United States Coast and Geodetic Survey. From these institutions a staff of 10 investigators was recruited, many of whom spent much of the time actually in the field aboard the United States Fisheries steamer *Shearwater*, which was assigned to the undertaking.

During the winter period, extensive improvements and alterations were made aboard the *Shearwater*, including the installation of a laboratory aboard, living quarters for five investigators, and various mechanical improvements.

The area of the survey was extended to cover the entire lake, with the exception of a portion of the western end, which was subjected to intensive investigation by the cooperative investigators of the State of Ohio and the Bureau of Fisheries, as previously mentioned. Actual field studies were pursued from May 15 to September 20 and consisted of four extended cruises from Buffalo to Put in Bay, requiring usually about 15 days, and numerous shorter cruises in other sections of the lake for intensive investigations of the hydrography and related physical problems. In all, 50 fixed stations were occupied on the longer cruises, providing records on about 270 series of observations distributed through 4,435 statute miles traversed by the vessel.

Routine physical observations were carried out, such as sounding for depth and for bottom samples, vertical and horizontal distribution of temperature, rate and direction of the movements of water, and determination of transparency. Chemical observations included the determination of dissolved oxygen, carbon dioxide, total alkalinity, and hydrogen-ion concentration, as well as occasional quantitative determinations of other elements and compounds. Biological observations included exact quantitative and qualitative determination of nanno-plankton and of the net plankton, and rough quantitative and qualitative determinations of net plankton, both vertically and horizontally, and similar determinations for macro-plankton, including young fish. Additional collections were made with seines

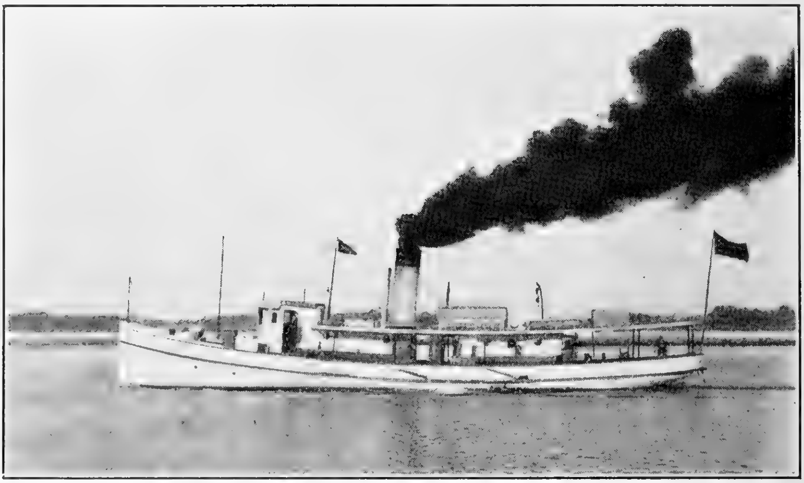

FIGURE 4.—U. S. F. S. *Shearwater* engaged in the cooperative survey of Lake Erie

and trawls to determine the distribution and relative abundance of young fish too large to be taken in plankton nets.

The results of the survey having immediate practical value may be summarized as follows: Physical observations established the fact that in addition to the cold-water mass previously discovered in the deeper eastern portion of the lake, a thermocline exists in the shallow western portion, during a part of the year, covering the greater part of the bottom of the lake with cold water. This thin layer of cold water in the western part is broken up, however, by late summer storms, and the deeper cold-water area varies materially throughout the season in both extent and position. The movements of the bottom cold-water mass are apparently governed by meteorological conditions, especially wind movements, and these in turn produce rhythmic oscillations of the surface waters as well as major displacements. Despite these considerable water movements, no currents were discovered that were strong enough to account for the destruction of nets.

Chemical observations show that pollution is not at present a serious menace to the fishery, being limited to the vicinity of the few large cities. Biological observations confirm the findings of the previous year's work and indicate that the natural production of small organisms, both plant and animal, upon which the fish life depends is adequate to support a much greater adult fish population than at present exists in the lake.

Although there is a considerable amount of valuable information on the adult fish of Lake Erie, little attention had been given previously to the survey begun in 1928 to the larval and early stages of development of the various fishes. The newly hatched fish seldom resembles its parent in external appearance, so that careful study was necessary to identify and describe the considerable number of species taken in the juvenile and larval stages. At the close of the summer's work, 14 species were described and figured, making it possible to follow the life histories of the more important forms with relative completeness.

When the technical data collected in the course of this survey are fully analyzed and the combined reports published, a sound foundation will be afforded for more exact studies of the commercial fishery and for an understanding of the movements and habits of the various food fishes now believed to be suffering from overfishing.

STUDIES IN WISCONSIN LAKES

GROWTH OF FISHES

The investigation of growth rates of fishes in lakes of northern Wisconsin, carried on by the bureau in 1927 and 1928, has been discontinued; and the Wisconsin Geological and Natural History Survey has taken over the problem. No fish were collected in 1929, but the scales taken in the previous years are being studied in the laboratory of the survey at the University of Wisconsin.

The results of the investigation of the rock bass have been reported in a recently published report. The paper may be summarized as follows: The growth curve of the rock bass, as indicated by a study of scales of fish from Trout and Muskellunge Lakes, Vilas County, Wis., typically has the double sigmoid form. The rate of growth in the second period of rapid growth is greater than that in the first. The first period occurs in the first year and the second in the fifth year. More individuals grow most rapidly in the fifth year than in any other; the second largest number grow most rapidly in the sixth year, and the third largest number in the fourth year. The rock bass of collections from Muskellunge Lake made in 1927 and 1928 grew at approximately the same rate. These collections were made in the same general locality and are regarded as representing a single population. Rock bass taken from Trout Lake in 1927 showed a much more rapid rate of growth than those taken in 1928. The two collections were made in different localities and are regarded as representing two distinct populations, each with a characteristic rate of growth. In comparing the two lakes for these years, it was found that in 1927 the rock bass of Trout Lake showed a more rapid growth rate; while in 1928 the condition was reversed, with those in Muskellunge Lake showing the greater development.

LIMNOLOGICAL STUDIES

Limnological investigations on the lakes of northeastern Wisconsin were continued during the summer of 1929 in cooperation with the Wisconsin Geological and Natural History Survey. The Trout Lake laboratory of the survey was opened on June 21, and work was continued until September 10.

The field party consisted of E. A. Birge, Chancey Juday, W. L. Tressler, Mrs. W. L. Tressler, J. P. E. Morrison, Edward Schneberger, Hugo C. Baum, biologists; Frederick J. Stare and F. Lowell Taylor, chemists. In addition chemical analyses of residues obtained by evaporating 3 or 4 liters of water, were made by C. H. Winning, T. F. Setterquist, and P. C. Cross, the work being done in the chemical laboratory of the University of Wisconsin.

The field studies included such physical items as the temperature, the transparency, the color and the conductivity of the water, and the rate at which the sun's energy is absorbed by the water in the different types of lakes. The chemical items consisted of the determination of the hydrogen-ion concentration, dissolved oxygen, free and fixed carbon dioxide, nitrate nitrogen, phosphorus, silica, chlorine, and total residue. The biological phases of the work included quantitative studies of the net and centrifuge plankton and of the bottom fauna, and a general survey of the large aquatic plants; a special collection of the molluskan fauna of the district was made. Observations were made on 293 different lakes and lakelets during the summer of 1929; of this number 157 had not been visited hitherto and 136 had been visited in former years. Series of samples covering the entire depth of the lake were obtained from 36 of these bodies of water. Adding to these the series of samples taken in previous years, such observations have now been made on every lake in the northeastern district which has a known maximum depth of 20 meters or more; many series have also been taken in shallower lakes, such as those with maximum depths falling between 6 and 20 meters.

Up to the close of the 1929 season, 479 lakes and lakelets have been visited during the progress of this investigation. This number includes all of the larger and more important lakes of the northeastern district. Several hundred lakelets in this area have not been visited, and only a few of the numerous bog ponds and lakelets have been studied; the present plans do not include an extensive survey of these smaller bodies of water in the near future.

PACIFIC COAST AND ALASKA FISHERY INVESTIGATIONS

The passing of the White law in 1924 greatly strengthened the powers of the Department of Commerce, acting through the Bureau of Fisheries, in making adequate regulations for the care and perpetuation of the fishery resources of Alaska. Recognizing that the regulations, to be most effective, must be based on a scientific knowledge of the species exploited, the bureau has, from the first, devoted efforts toward the study of the more important problems. Many of the investigations have been concerned with purely local practical problems but others of broader and more general application have had an important place on the program. The practical value of the results has been sufficient to warrant a gradual increase in the work done in this field.

New investigations begun during the past year have included a study of the homing instinct of pink salmon in southeastern Alaska, the investigation of the red salmon of the Copper River and the investigation of the red salmon of the Bristol Bay district. The work is under the direction of Dr. Willis H. Rich.

The staff engaged in these investigations has been brought together in quarters provided by Stanford University in the Natural History Museum. Ample laboratory space has been provided; and laboratory furniture, the ichthyological library, and a considerable amount of apparatus is made available by the university without cost to the Government. These arrangements have been made through the fine cooperation of the university authorities, especially Prof. J. O. Snyder.

ALASKA SALMON

Tagging experiments.—Continuing the series of salmon-tagging experiments that have been conducted in Alaska since 1922, approximately 4,000 salmon were tagged in central Alaska during the summer of 1929. Of this number 1,900 were tagged in Cook Inlet and about 2,100 in Prince William Sound. The work was done by Seton H. Thompson under the direction of Dr. W. H. Rich.

The Cook Inlet operations consisted of seven experiments in which four species of salmon were tagged. Approximately 41 per cent of the fish were sockeyes, 41 per cent pinks, 12 per cent chums, and 3 per cent cohos. The experiments were conducted at four different localities—Flat Island, Nubble Point, Cape Starichkof, and Nikishka Bay. Tagging was done during the early part of the season, and again during the latter part of the season when the run was at its maximum. About 600, or 31 per cent of these tagged fish, were recovered and reported.

The Prince William Sound tagging operations were conducted in nine experiments at five different localities during the early part, the height, and the latter part of the season. Of the number tagged, approximately 97 per cent were pinks, and the remainder were mostly chums. About 500, or 21 per cent, of the tagged fish were reported taken in different parts of Prince William Sound.

The results of these experiments are now being tabulated and studied, and it is expected that a report will be submitted for publication within a few months.

Statistics of the Alaska salmon fisheries.—The work of compiling and tabulating these data has been continued by Dr. W. H. Rich and E. M. Ball, assistant, Alaska service, and is now practically complete. Tables have been prepared showing the catch in each district from the beginning of the industry up to and including 1927, and the analysis of these tables is now under way. The preparation of a second number in the series of statistical reports dealing with the fisheries of central Alaska will be completed within a few months.

Karluk River investigations.—The intensive study of the red salmon runs of the Karluk River, Kodiak Island, Alaska, have been continued by W. H. Rich, A. C. Taft, and M. W. Brown. Another experiment was begun, which involved the marking of 50,000 seaward migrants during June, 1929. The seaward migration this season appeared to be extraordinarily heavy. It was derived chiefly from the unusually large spawning escapement of 1926, when a total of approximately two and a half million adults passed through the counting weir. The returns from this experiment will therefore be awaited with great interest. The run of adult red salmon at Karluk in 1929 was exceedingly poor—a condition that had been anticipated and discussed in a report published in 1927.[3] As a result of this poor run, the commercial fishing operations at Karluk were so restricted during the past season that it was impossible to secure reliable data as to the number of marked fish in the run from previous marking experiments, nor was it possible to satisfactorily sample the run for a study of the age groups and other related problems.

A second report dealing with the red-salmon runs of the Karluk River has been nearly completed. It includes the presentation of all data accumulated since 1926, especially the results of the markings experiment begun in 1926.

Of the 46,700 fish marked in 1926, between 25 and 30 per cent returned as mature fish. This is a much higher return than was expected a priori and on the basis of the returns from similar marking experiments conducted at the hatcheries on the Columbia River.

In addition to estimating the survival, there was a second and corollary purpose in instituting these marking experiments. This was to determine the total number of seaward migrants and the age groups represented. The 46,700 migrants marked in 1926 made up an unknown proportion of the total number, but it was a proportion which could be expected to remain constant until the fish returned at maturity, provided that there was no differential mortality between marked and unmarked fish. In controlled experiments conducted on the Columbia River it has been shown that there is practically no increased loss following marking. Our computations show the total number of seaward migrants in 1926 to be approximately 7,500,000.

This is the first attempt to calculate the size of the seaward migration at Karluk by means of marking experiments combined with careful and extensive sampling of the runs for marked fish. The results are interesting and it is believed that they are fairly reliable, but it will necessarily be several years before we can have data that will enable us to determine the relative accuracy with which we can calculate the total number of migrants produced by a given spawning escapement.

In connection with the annual weir count of the spawning fish we have, then, the means of determining the following variables involved in the productivity of the stream: (1) The number of fish in the spawning escapement, (2) the number of migrants produced by each spawning escapement, and (3) the number of fish from each migration which survive to maturity. The value of such data accumulated over a series of years can scarcely be overestimated. It

[3] Investigations concerning the red-salmon runs to the Karluk River, Alaska. By Charles H. Gilbert and Willis H. Rich. Bulletin U. S. B. F. XLIII, 1927 (1928), Part II, pp. 1–69, Document No. 1021.

will be of the utmost value in the formulation of conservation measures which will both insure the maintenance of these great natural resources and, at the same time, allow the maximum catch for commercial purposes.

The study of conditions on the spawning grounds at Karluk Lake was continued by W. H. Rich and M. W. Brown. The lake was visited in July and again early in September. Physical conditions appeared to be satisfactory so far as temperatures and water supply were concerned, but, on account of the very poor escapement, the spawning grounds were seeded more sparsely than in any year since regular observations were started. A fairly good escapement was reported during September, however, and it may be that this will be sufficient to produce a moderate run in 1934—the year in which most of the

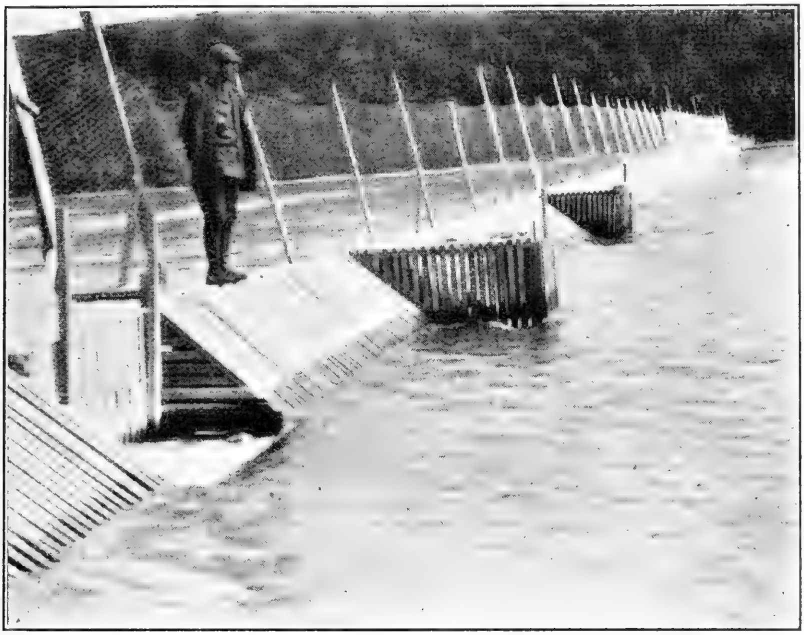

FIGURE 5.—A salmon counting weir in Alaska. Enumerators count each fish that passes through the opening shown in the foreground

progeny of the 1929 escapement will return as adults. Otherwise the prospects for 1934 are by no means bright. In addition to observations on the spawning grounds, plankton samples and temperature records were secured which have been submitted to Prof. Chancey Juday of the University of Wisconsin for study.

Chignik River investigations.—An intensive investigation, similar to the one at Karluk, is in progress at Chignik by H. B. Holmes. As at Karluk, this investigation has for its chief objective the determination of the relation between the number of fish in the spawning escapement and the resultant number of mature fish.

The irregularities in the life history of the fish that cause difficulty in scale interpretation are confined to the time the fingerlings spend in fresh water before migrating to the ocean. A study of this part of the life history was started in 1928.

Observations during the first season were confined mainly to the seaward migration of fingerlings. A more intensive study of the young fish was undertaken in 1929 by Mr. Holmes, assisted by a temporary assistant, and had for its purpose the tracing of the growth of the fish from the time they emerge from the gravel of the spawning grounds until they migrate to the ocean.

Bristol Bay investigations.—Bristol Bay comprises one of the most important red-salmon producing areas in Alaska. The annual pack averages approximately a million cases valued at about $10,000,000. The study of the salmon runs here was interrupted by the death of the late Dr. C. H. Gilbert but is now being taken up by A. C. Taft. During the past year a boat-catch analysis of the Nushagak region has been begun. The data were made available through the courtesy of the Alaska Packers Association of San Francisco. From their books it was possible to get data for the individual catch per boat from 1903 to 1928. This work extends and supplements the statistical review of the fisheries of Bristol Bay made by Rich and Ball (Document No. 1041). From a preliminary study it appears that there is a very high correlation between the catch per boat per season and the total catch per season. It would thus appear that, for the Nushagak region, the total catch provides an entirely adequate measure of the abundance of fish from year to year. The study of numerous scale samples from Bristol Bay has also been started as a basis for a detailed investigation of the age-group composition of the runs in the several districts.

Copper River red salmon.—A comprehensive investigation of the Copper River red salmon was undertaken by Seton H. Thompson in the season of 1929. These fish formerly provided an important element in the salmon resources of Alaska but in recent years have shown signs of serious depletion. Scales were taken from a sample of the commercial catch each day during most of the season. In the latter part of August and in September, observations were made on the more accessible spawning grounds.

Pink salmon investigations.—In view of the growing demands of the commercial fishery upon the pink salmon of Alaska, an investigation for the purpose of studying their life history and the causal factors underlying the fluctuations in their abundance was started in the summer of 1929 by Dr. F. A. Davidson. The point considered most pressing for early settlement was whether or not the " parent-stream theory " applies to the pink salmon, as the relative strength of the homing instinct will influence the drafting of protective regulations to insure abundance in the future.

The field work began in July and was confined to the territory of southeastern Alaska, this district being chosen on account of the extensive pink-salmon fishery it supports. Samples of the pink-salmon populations of 12 important streams, located in the various fishing districts, were taken for the purpose of ascertaining the possibilities of making a racial analysis of their populations.

Forty-six pink-salmon streams located in the various fishing districts in southeastern Alaska were visited and data collected on the physical and chemical characteristics of the stream and on the spawning populations.

COLUMBIA RIVER SALMON

Salmon-marking experiments conducted on the Columbia River in cooperation with the Oregon Fish Commission have been continued by Mr. Holmes. A report by W. H. Rich and H. B. Holmes, covering experiments with chinook salmon, has been published during the year and a similar report by Mr. Holmes, dealing with sockeye salmon, is nearing completion.

Field work during the year 1929 was restricted to the recovery of mature fish which had been marked as fingerlings. The majority of the recoveries were from an experiment with spring chinook salmon conducted at the Oregon Fish Commission's hatchery on the McKenzie River. This experiment was designed to furnish information on the very practical problem of how long fingerlings should be retained at the hatchery in order to produce the greatest number of adult fish. The experiment involved 5 lots of 50,000 fingerlings which were marked and liberated in May, June, July, and September, 1925, and March, 1926, respectively, when the fish were 8, 9, 10, 12, and 18 months old, respectively (age including period of incubation). This particular experiment failed to indicate any preference for one age of liberation over another. The results of this experiment agree with previous experiments in showing that the chinook salmon which spawn in the McKenzie River start their spawning migration early in the season, and that chinook salmon have a strong tendency to return not only to their "parent" river system, but also to the particular tributary in which they spent the early part of their lives.

ALASKA HERRING

In June, 1929, a scientific report was submitted for publication by George A. Rounsefell, summarizing the investigation from its beginning in 1925. It contains a brief description of the fishery, its methods, and development; and sections dealing with the general life history, the independence of the populations of various localities, the spawning habits, the determination of age and rate of growth, the changes in the condition of the fish, the composition of the catch with its relationship to natural fluctuations in abundance, analysis of the statistics of the catch, and a summary of the evidence of depletion.

During 1929 field work was carried on in both southeastern and central Alaska by George A. Rounsefell and Edwin H. Dahlgren, temporary assistant. Before making a detailed analysis of the daily herring catch records for each boat, which are being constantly collected, it is necessary to have a fairly accurate knowledge of the localities inhabited by each race of herring. This will allow areas to be laid out for statistical and biological use, each of which will embrace as homogeneous a population (from a racial standpoint) as possible. To this end racial data were taken in southeastern Alaska and Prince William Sound on about 7,000 specimens from the commercial catch. In addition, in southwestern Alaska, a small boat was chartered and samples of herring were caught with gill nets in several localities in the inside waters, and preserved in formalin for later examination. No commercial fishery of any importance exists in these localities at the present time. In those localities which the scientists were not able to visit during the summer, series of samples were taken and preserved in formalin by the bureau's patrol service.

RAZOR CLAMS

As long as the razor clam industry retains its present value, certain facts must be gathered annually, that they may be made available for future comparison and that they may serve as an index to the condition of the beds. A general survey of the industry including the intensity of digging, the area being exploited, and the age of the clams in the commercial catch, is essential.

During the season of 1929, observations were confined to the vicinity of Cordova, where the most important Alaska fishery is located. Statistics designed to show the intensity of fishing have been gathered, and a study is being made of the age composition of the commercial catch in order to detect evidence of depletion. New collections of shells from the bars were made by Seton Thompson, and a part of them have been measured and recorded, under the direction of Dr. F. W. Weymouth of Stanford University, with the intention of comparing the growth rate of the clams on different bars in that locality.

CONSERVATION OF FISH BY MEANS OF SCREENS AND LADDERS

The investigation on the conservation of fish by means of screens and ladders was begun in 1928 and continued in 1929 under the direction of Shirley Baker, consulting engineer, assisted by U. B. Gilroy. The purpose of this investigation is to develop and install mechanical and electrical devices which will prevent fish from entering irrigation ditches. Enormous numbers of fish, chiefly salmon, which have entered these ditches, are killed each year when the ditches are dried up at the end of the irrigating season.

The activities under this investigation during 1929 were as follows: (1) The construction and operation of six electric fish screens on waterways of major importance, together with extensive experimentation on these devices for the purpose of simplifying and improving them; (2) the installation of a mechanical revolving fish screen; (3) the installation of a large concrete fish ladder; (4) studies of models and designs of fish ladders as well as the specifications for the fish ladders required at a number of locations; (5) analysis of the effects of five major hydroelectric developments proposed for the Northwest with the specifications of the necessary structures required for fish protection; (6) study of the practice of the Canadian Government in the matter of fish ladders; and (7) miscellaneous services rendered to State commissions and commercial bodies in the interest of fish conservation.

MECHANICAL FISH SCREENS

The most practical and economical type of mechanical fish screen is the one that has been adopted by the Oregon Game Commission and the Washington Division of Fisheries. This screen consists essentially of a cylinder of heavy wire mesh material, placed in an appropriate supporting structure and made to revolve on a horizontal axis in the direction of the stream flow. The motive power is furnished by paddle or bucket wheel placed in the ditch below the screen, and a necessary by-pass channel is provided for the return of the fish to the main stream. The economic field of application for screens of this type seems to be the small to moderately large diversions.

As part of the work of this investigation the Bureau of Fisheries has designed and is now completing the installation of a revolving screen of this type on the Atanum ditch of the United States Indian Service. This ditch diverts water from Atanum Creek, about 17 miles southwest of Yakima, Wash.

Atanum Creek is frequented by both salmon and steelhead, and for a number of years there has been heavy loss of downstream migrants into this unscreened ditch.

W. R. Coleman, superintendent of fish screens and fish ladders for the Oregon Game Commission, has assisted in design and construction. The entire cost of the installation has been borne by the United States Bureau of Fisheries.

ELECTRIC FISH SCREENS

Early in the investigation the possibilities of the electric screen were realized. In the summer of 1926 Prof. F. O. McMillan, department of electrical engineering, Oregon Agricultural College, and J. E. Yates, engineer, Pacific Power & Light Co., Portland, Oreg., conducted experiments on the electric fish screen at Bonneville hatchery, Oreg.[4] In the spring of 1928 Messrs. McMillan and Yates installed for the California-Oregon Power Co. an electric fish screen in the tailrace of the power plant at Gold Ray on the Rogue River in Oregon. In September, 1928, H. T. Burkey of Pasadena, Calif., holder of United States patents on the electric fish screen requested opportunity to show his device, which was afforded him at the Delph Creek hatchery, Oreg., where he set up a small installation for a demonstration. Though made in still water and against trout this demonstration was sufficiently interesting to warrant a large-scale test under actual field conditions. This installation was made by the United States Bureau of Fisheries in the Tieton Canal of the United States Reclamation Service and was operated for a month.

These experiments seemed to justify making permanent installations with the result that plans were adopted and carried out to place electric fish screens of this type at the following locations: (1) Sunnyside Canal, Yakima project, United States Reclamation Service; (2) Tieton Canal, Tieton project, United States Reclamation Service; (3) Wapato Canal, Wapato project, United States Indian Service; and (4) intake of Gold Ray power plant, California-Oregon Power Co.

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[4] Electric Fish Screen (with bibliography); by F. O. McMillan. Bul., vol. 44, 1928. 34 pp., 21 illus.

EFFECTIVENESS OF SCREENS

For the past two years the Division of Fisheries, State of Washington, has done valuable work in the interests of fish conservation, by maintaining a special investigator in Yakima County during the irrigation season to secure data on the presence of fish. On this work hundreds of miles of ditches and stream channels are patrolled weekly.

In the fall of 1929 the United States Bureau of Fisheries and the State division of fisheries cooperated in the work of the final check on the ditch system, Fred R. Lucas, representing the bureau. In this work the projects reported on were covered in their entirety. The results constitute data of a very high degree of accuracy.

Sunnyside electric screen.—The Sunnyside Canal, main diversion of the Yakima project, United States Reclamation Service, diverts water from the Yakima River, near Yakima, Wash. The capacity of the canal is 1,500 second-feet. The irrigation season of 1929 extended from March 15 to October 21. During the greater part of the season the canal carried from 1,200 to 1,500 second-feet. The check revealed a total of 640 salmon and steelhead left stranded in the system. Of this number 480 were actually caught and counted. In length, the fish averaged from 3¼ inches to 5 inches. It is reported that in former years the Sunnyside and Wapato systems were likely to show hundreds of thousands of such fish. The results indicate the operation of the electric screen to have been a success.

Tieton electric screen.—The Tieton Canal of the United States Reclamation Service diverts water from the Tieton River at a point about 35 miles northwest of Yakima, Wash. Capacity of the canal is 320 second-feet, and this flow is maintained throughout most of the irrigation season. Because this diversion is located in the mountains many miles from any power line, it was necessary to install a power unit for furnishing electricity to the screen. This was accomplished when the United States Reclamation Service, displaying a fine spirit of cooperation, installed at their own expense a hydroelectric generator on the Tieton ditch and built a transmission line three-fourths of a mile long to bring the power to the screen. The electric screen went into operation three and one-half months after water diversion started, consequently, the effect of the electric screen can not be determined from check on the fish in the ditch at the end of the season. In comparison with 1928 this year's check showed more small salmon and steelhead and less large ones. The fish in the Tieton River, both above and below the diversion point, were much more numerous this season than in 1928. All factors considered, the use of the electric screen is regarded as successful.

Wapato electric screen.—The Wapato Canal of the United States Indian Service diverts water from the Yakima River at a point about 3½ miles upstream from the Sunnyside Dam. The capacity of the canal is 1,800 second-feet, and throughout the major portion of the irrigation season this huge flow is maintained. The irrigation season is from March 15 to November 18. A check of the system showed the total number of salmon and steelhead to be about 900, of which 381 were actually caught and counted. The average length of the fish was from 3½ inches to 5 inches.

The efficiency of the Wapato electric screen can not be determined from the number of fish left in the ditch at the end of the season because, for a time, fish passed into the system through the Old Indian Canal which was unscreened. Taking this into account, the results indicate that the electric screen was a success. For the purpose of comparison a check was made at the end of the irrigation season on the Selah-Naches ditch where there is no screening device.

This ditch, operated by a private irrigation company, diverts water from the Naches River (a tributary of the Yakima) in the same district with the Sunnyside and Wapato Canals. The ditch capacity is about 300 second-feet. In the check up on this ditch there was found a total of 5,900 salmon and steelhead 3 to 8 inches long. Of this total 5,389 were actually caught and counted. All the fore-

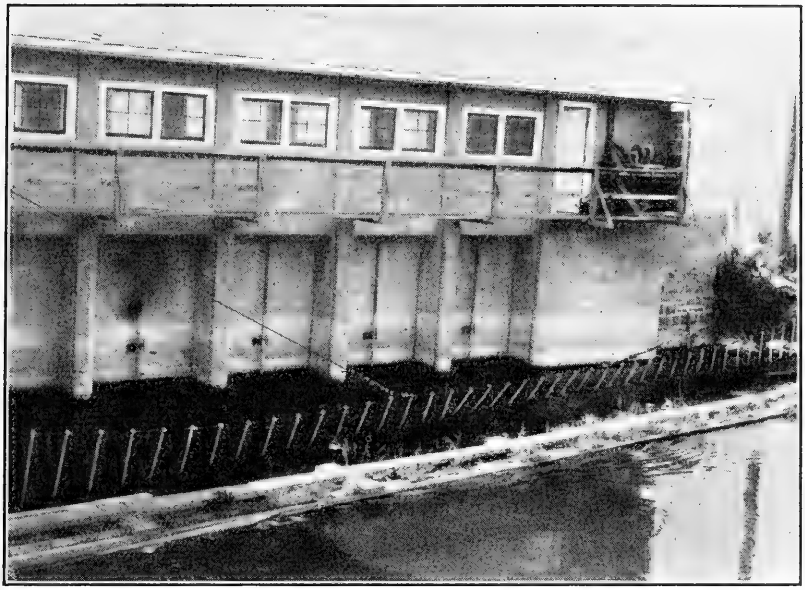

FIGURE 6.—The Wapato electric fish screen. Chain electrodes are seen hanging in front of the diversion gates

going installations were under the competent care of W. N. Wagner, inspector United States Bureau of Fisheries.

Gold Ray intake screen.—The purpose of this electric screen is to prevent downstream migrating salmon and steelhead from being drawn into the power turbines. The Gold Ray Power House of the California-Oregon Power Co. is situated on the Rogue River near Medford, Oreg. Water is diverted to the turbines through an open channel blasted in rock. The screen was electrified June 3, but results were not satisfactory. Experimentation with a view to improving conditions was carried out throughout the summer. Early in August a survey of the distribution of the electric field set up in the water was made by Prof. F. O. McMillan. This revealed high and undesirable voltage gradients at the chain electrodes and along the masonry wall at the south side of the intake.

As a means of alleviating this condition of high-voltage gradients and following very encouraging results at an experimental electric screen erected for this purpose in the Gold Ray sluiceway, the use of the grounded type of screen was abandoned and a screen insulated from ground and employing a double row of large diameter pipe electrodes was installed. Operation of this screen was continued until late in November, but no real check on its efficiency was possible because the season for downstream migration of fish had almost wholly passed. The operation of the grounded screen throughout the migration season without question diverted some fish from the intake channel, but it is doubtful if the number so diverted was more than 25 per cent of the total number of such fish encountering the screen. It is felt that greatly improved results will be obtained with the new screen the coming season.

Gold Ray sluiceway experimental screen.—During the late summer considerable experimenting was done with a view to determining the best type of electric screen for operation against downstream migrants. The first experiments were made with the grounded type of screen as employed at all previous installations. The action of the fish was noted under a variety of conditions. Various arrangements of spacing electrodes and ground element with voltages ranging from 45 to 110 volts were tried. The action of the fish in the electrified zone was erratic. Resort was then had to a screen insulated from the ground, and highly satisfactory results were obtained.

Gold Ray tailrace screen.—Three heavy runs of salmon and steelhead pass up the Rogue River each season on their way to the spawning beds. For the accommodation of these upstream migrants two fish ladders are maintained at Gold Ray Dam, one being at each abutment of the dam. The discharge from the power-house tailrace returns to the river about 500 feet downstream from the dam. During periods of large overflow the volume of water in the main channel is sufficient to keep most of the fish safely headed up past the tailrace to the fish ladders. When, however, the overflow at the dam is diminished and a considerable part of the river flow is being taken through the power house, these fish are attracted into the tailrace. Trapped in this channel they wear themselves out fighting the strong flow from the turbines and are thus prevented from reaching their goal up river. In the spring of 1928 the California-Oregon Power Co. installed and, for a time, operated an electric fish screen in this tailrace. The results obtained encouraged further investigation, and to this end the power company has cooperated with the Bureau of Fisheries in bearing one-half the expense of all work done on the Gold Ray electric screens this season.

The object of the experimental electric screen installed by the bureau in the tailrace was twofold. Primarily the purpose was to screen this waterway against the entrance of upstream migrating fish and thus divert them upstream to the fish ladders. It was also desired to study the possibility of directing fish to some definite point in a channel by means of an electric field. With this latter purpose in view the screen was installed well up in the tailrace and diagonally across it. At the upstream end of the screen a fish trap or box of timber construction was placed; the object being to see if the fish upon coming in contact with the electrified-zone of water would continue to work up along the edge to the unelectrified section of channel occupied by the trap. After several weeks of operation, during which time many fish were stopped by the electric screen, but none were found to enter the trap, further work with the latter was abandoned.

Throughout the season many people had an opportunity to observe hundreds of salmon and steelhead in contact with the electric field. Some of these fish were stopped at the weak fringe of electrical effect just downstream from the ground pipe. The majority would penetrate the electrified zone for from 5 to 8 feet, where they would break water in a mighty leap and, turning around, swim rapidly out of the tailrace. A very few fish were seen to pass through the screen, but this was exceptional. A happy feature of the season's operation was the almost complete absence of killing or stunning of fish due to contact with the electric field. High success has attended the operation of this screen. It is estimated that, during the summer, upward of 5,000 salmon and steelhead attempted to pass through the electric field. Brief shutdowns of the power house were made upon several occasions for cleaning fish out from above the screen. The results of these checks indicate that the efficiency of the screen may conservatively be taken as from 95 to 98 per cent.

Electrification of Savage Rapids screen.—At the Savage Rapids Dam on the Rogue River the Grants Pass irrigation district operated a pumping plant to deliver a total of 110 second-feet of water to two high-line ditches. Several years ago the Oregon Game Commission installed a "roller-towel" type of mechanical screen in front of the intakes to prevent downstream migrating salmon and steelhead from being sucked into the turbines. With this large-mesh screen remaining stationary it is known that great numbers of small fish are drawn through it to the turbines. This summer, at the request of the Oregon Game Commission, and with that body and the Oregon Fish Commission bearing the expense, the United States Bureau of Fisheries converted the installation to an electric screen. In this work Prof. F. O. McMillan served in a consulting capacity.

Naches power house electric screen.—In February, 1929, the Pacific Power & Light Co. announced its willingness to install at its own expense electric fish screens at the company's power intakes in Yakima County and requested the United States Bureau of Fisheries to specify and design the screen; accordingly the bureau specified the materials and designed the screens for the Naches and Fruitvale plants. These screens were similar to the installations being made in the Government ditches.

FISH LADDERS

The field work of 1928 included the inspection of practically all fish ladders in the States of Washington, Oregon, Idaho, and Montana. Studies of these installations and observations of the habits of migratory fish revealed certain basic principles which should govern the design of fishways. The activities of 1929 have included: (1) The practical application of these basic principles in the construction by the United States Bureau of Fisheries of a new fish ladder at the Sunnyside Dam of the Yakima project, United States

Reclamation Service; (2) field inspection and preliminary work on the design of a new fish ladder for the Sprague River Dam of the United States Indian Service; (3) conference with the chief engineer of fishways, Canadian Government; (4) field inspection of the dam sites of several proposed power developments, and the study of models and designs of fish ladders for the purpose of specifying the required structures of these projects.

The Sunnyside fish ladder.—Four important runs of anadromous fish journey up the Yakima River each season; these being the spring and summer runs of the chinook salmon, the steelhead, and the fall run of the silver salmon. To reach the spawning beds these fish must pass over the Sunnyside Dam. This concrete overfall dam has a crest length of 500 feet and a height of 7.5 feet from stream bed to crest, which is increased to 10 feet by the additional flashboards. These flashboards are maintained in position for the major portion of the irrigation season. At times of high flow the upstream migrants can negotiate the jump at this dam, but with the flashboards in place and under the condition of small overflow that prevails during most of the irrigation season, the jump becomes impossible for most fish. Realizing the unfavorable conditions existing at the Sunnyside Dam the United States Bureau of Fisheries designed and constructed this fall, a ladder of large pool design which has already proved itself a real factor in fish conservation on the Yakima River.

Preliminary work on Sprague River fish ladder.—The assistance of the United States Bureau of Fisheries has been sought by the Oregon Game Commission to improve conditions at the Sprague River Dam of the United States Indian Service, near Chiloquin, Oreg. In response to this appeal the bureau plans to construct an adequate fish ladder at the site. Conditions at the site have been inspected and the necessary measurements and data secured. It is the intention to design and build this structure during the coming summer, providing sufficient funds are available for the work.

Study of Canadian practice.—In November, under instructions from the Commissioner of Fisheries, a visit was made to Ottawa, Ontario, for the purpose of interviewing the engineers engaged in fish-ladder work for the Department of Marine and Fisheries, Canadian Government. William Found, the departmental head, and Charles Bruce, chief engineer of fishways, were most cordial in placing all of the Canadian material at the disposal of the bureau's engineers.

Fish ladders at new power projects.—During the past year the scope of this investigation has been considerably enlarged on account of obligation of the Bureau of Fisheries to specify the fish ladders required at two major power developments on the Columbia River. It is believed that this service is highly important. The projects referred to are Rock Island development of the Washington Electric Co. and the Kettle Falls development by the Washington Water Power Co.

INVESTIGATIONS IN TROUT CULTURE

At the present time practically all the investigations in connection with trout culture are being carried on at the bureau's experimental hatchery at Pittsford, Vt., under general supervision of

Dr. H. S. Davis, in charge aquicultural investigations. The work at this hatchery, which is under the immediate supervision of R. F. Lord, is primarily concerned with brook trout, and a large stock of these fish of various ages is maintained for experimental purposes. Small numbers of rainbow, steelhead, and black-spotted trout are also kept at this station, and during the past summer the stock was increased by a shipment of grayling eggs from Montana. In order to accommodate such a large and varied assortment of fish a large number of small ponds and raceways are required, and these are being increased as rapidly as funds will permit.

During the past season the brook trout spawned at this station produced approximately 950,000 eggs. These eggs were taken from several strains of fish originally obtained from widely separated sources so that trout of quite different ancestry will be available for breeding purposes. In addition to the brook-trout eggs, several thousand rainbow eggs were also taken. It may be of interest to note that there are two strains of rainbow trout at the station, one spawning in the spring and the other in the fall.

FEEDING EXPERIMENTS

The feeding experiments carried on during the summer of 1929 were planned along the same general lines as in the previous year. Fingerling and yearling brook trout were utilized in these experiments, the fingerlings being kept in hatchery troughs, while the yearlings were held in outdoor raceways. Twenty-one lots of fingerlings, containing 1,500 fish each, were kept on experimental diets which were designed primarily to furnish additional data on the feasibility of utilizing dry meals in rations of fish of this age.

Dry feeds for fingerling brook trout.—As a result of the experiments during the last two years in feeding substitutes for fresh meats to fingerling trout, it is believed that it is entirely practicable to use certain dry products in combination with fresh meat at a considerable saving over the cost of a straight fresh-meat diet. These experiments have shown that fingerlings fed a mixture of fresh meat and certain dry products do fully as well as fish on a diet of fresh meat alone, and in some instances even better. It is not believed however, that in most instances it will be found practicable to feed these dry products to fish under 2 inches in length.

Only a few dry products have been found to give satisfactory results with small fingerlings. Clam meal has made by far the best showing of any of the dry products tested, but unfortunately the supply of this meal is very limited. Dry buttermilk and dry skim milk have also been found to produce good results and, everything considered, are probably the best dry products for feeding small fingerlings which are available in quantity. As high as 25 per cent of these meals when mixed with beef liver has been found to yield results comparable to those obtained with liver alone.

After the fingerlings reach a length of 4 to 5 inches a wider range of dry meals is available, such as shrimp meal and vacuum-dried fish meals.

Dry feeds for yearling brook trout.—The experiments with yearling brook trout during the summer of 1929 were conducted on a larger scale than ever before, 24 lots of fish being placed on experimental diets. The results were very consistent and in general agreement with those obtained in previous years. The advisability of using dry meals in the ration as a measure of economy was fully demonstrated and it is confidently believed that by the utilization of these products the food bill can be reduced at least one-third without adverse effects on the growth or mortality.

While the results of these experiments clearly indicate that trout can not be kept successfully on dry foods alone for any length of time, they also show that the amount of fresh meat required is less than was formerly thought to be the case. Excellent growth accompanied by low mortality was obtained with rations containing as high as 60 per cent of dry meals and it is probable that the amount of meat can be still further reduced without appreciably lowering the efficiency of the ration.

Unfortunately, owing to local conditions, it has been found impracticable to continue the feeding experiments during the winter at the Pittsford station. Since it is evident that the practical value of these experiments is dependent to a large degree upon the length of time they can be continued without interruption, it is highly desirable that facilities be provided elsewhere for carrying on feeding experiments throughout the year. Furthermore, the investigations at Pittsford have shown that the nutritional requirements of other species of trout are in some respects quite different from those of brook trout. Consequently it will be necessary to conduct similar experiments with rainbow and brown trout before the most desirable rations for these fish can be worked out.

BREEDING EXPERIMENTS

As noted in previous reports, experiments in selective breeding have been carried on at the Pittsford station during the past three years. Owing to the necessity of rearing a large brood stock in preparation for the breeding work it was possible to mate only a few pairs of fish previous to 1928. In the fall of that year 34 pairs were mated and the offspring kept in separate compartments in hatchery troughs during the following summer. These fish were all kept under as nearly identical conditions as possible so that the young of different parents would be directly comparable. Although all the parents were specially selected fish it was found, as was to be expected, that the young in different lots showed marked differences in rapidity of growth. The variations in growth among the fish in each lot were, however, much less than is usually the case among fingerlings of mixed parentage. In some lots the average growth was over three times that of other lots, and there is no question but that this difference in the growth rate must be ascribed very largely, if not entirely, to difference in parentage. Only those lots of fingerlings showing exceptional vigor and rapidity of growth are to be retained for further breeding work.

During the present season an even larger number of individual pairs have been mated and the eggs and young will be kept separate throughout the spring and summer. For the first time it has been possible to mate selected young of known ancestry and the results of these matings are awaited with a great deal of interest.

While it will, of course, require several years before results of permanent value can be expected from this breeding work the outlook is very encouraging and there is every reason to believe that in this way it will be possible to produce a marked improvement in the quality of hatchery fish. The marked differences in the vigor and growth of the offspring of different pairs are especially noteworthy. In many instances the parents of these fish showed little difference in either size or vigor and in ordinary hatchery practice would have unquestionably been considered of equal value for breeding purposes.

Value of various sized fish for stocking purposes.—In order to obtain more accurate data regarding the survival of hatchery fish when used for stocking purposes, arrangements have been made to stock several streams in the vicinity of the Pittsford station with fingerling trout of various sizes. It is planned to stock a stream

FIGURE 7.—Spawning selected pairs of trout used in breeding experiments at the Pittsford (Vt.) experimental hatchery. By careful selection of the parents, a superior strain of brood fish is developed

with trout of a certain age for two or three years and through cooperation of the local fish and game associations obtain data on the catch of a number of anglers on the stream. Later the same stream will be stocked with fish of a different size and the catch of the same anglers compared with their catch in previous years. In this way it is hoped to obtain data which will have a direct bearing on the much-discussed problem of the relative value of trout of different ages for stocking purposes.

Propagation of graylings.—During the summer of 1929 a shipment of several thousand grayling eggs was received at the Pittsford station from the Meadow Creek (Mont.) substation of the bureau. These eggs were received in exceptionally good condition and hatched with very little loss. Although it is generally believed that grayling are very difficult to rear no trouble was experienced in getting the fry to feed on very finely ground beef liver. They made a very rapid growth on this diet, and the losses were comparatively light. The grayling fingerlings continued to thrive throughout the summer, and on October 1 many had reached a length of 2 to 2.5 inches. With the arrival of cold weather the growth rate was reduced, but the fish remained healthy; and there is every reason to believe that they will survive the winter in good condition.

It is planned to use part of these grayling to stock a suitable stream in the vicinity of Pittsford, while the remainder will be reared to maturity at the hatchery.

DISEASES OF TROUT

Investigations on the parasites and diseases of trout were continued, special attention being paid to the gill disease which has been found to be one of the most serious diseases with which the trout culturist has to deal. It is a very widely distributed disease, having been found in trout and salmon from the New England States to the Pacific coast. Undoubtedly the disease has been prevalent at trout hatcheries for many years, but its true nature has only recently been recognized. Formerly losses which were evidently due to this disease were ascribed to the water supply and other obscure agencies. Fortunately, as noted in previous reports, the disease is easily controlled if the appropriate measures are taken on the first appearance of the infection.

An epidemic of "popeye" which caused serious losses among fingerling black-spotted trout and sockeye salmon at the Birdsview (Wash.) station was found to be associated with infection of the kidney by a myxosporidian parasite. This parasite, which is apparently an undescribed species of Myxidium, occurs in the lumen of the kidney tubules causing pathological changes in the epithelial lining. The "popeye" condition is due to the accumulation of serous fluid in the abdominal cavity and other parts of the body and it is probable that this is the result of the kidney infection.

INVESTIGATIONS IN POND FISH CULTURE

The investigations in pond fish culture at the Fairport (Iowa) station, under the immediate direction of Dr. A. H. Wiebe, were continued along the same general lines as in previous years under the general supervision of Dr. H. S. Davis. The object of these experiments is to devise better and more efficient methods of propagating and rearing the so-called warm-water game fishes, including the large and smallmouth black bass, the white and black crappie, and the bluegill sunfish.

Experiments with golden shiner and blackhead minnow as forage.—Since previous experiments had shown the advisability of utilizing forage minnows in rearing both large and smallmouth bass, the investigations during the past year were designed primarily to furnish further information regarding this phase of bass culture. Experiments with the golden shiner and blackhead minnow have shown that as a forage fish for bass the shiner is superior to the blackhead. There still remained, however, a possibility that both species of minnows in a pond would prove superior to either one alone, since they differ widely in their feeding and breeding habits.

However, this did not prove to be the case, for the ponds stocked with golden shiners alone produced approximately 8,000 largemouth fingerlings per acre, while the ponds stocked with both shiners and blackhead minnows only produced approximately 4,100 largemouth fingerlings per acre.

Number of forage fish required.—Additional information was obtained on the number of forage fish required to give the best results in rearing ponds. Each year the number of adult shiners placed in the ponds has been increased since experience has shown that practically all the minnows were devoured by the bass before the ponds were drained in the fall. This resulted in cessation of growth and an increase in cannibalism. During the past season the rearing ponds were stocked with about 700 adult shiners to the acre, and this is probably not far from the proper number to use in ponds containing only fingerling bass. Obviously when the ponds contain brood fish in addition to fingerlings the number of forage fish must be correspondingly increased.

Number of bass fry and adults for stocking ponds.—The number of bass fry required to produce the best results has also received attention, and we are now stocking the ponds with about 25,000 advanced fry per acre, which is considerably more than have been used in the past. Possibly as a result of increasing the number of fry the maximum production of bass fingerlings was increased from 10,000 to 11,500 per acre.

The total number of bass fingerlings produced at the Fairport station in 1929 was not as great as anticipated, owing to the fact that the bank of the largest rearing pond was washed out shortly after the pond had been stocked for the summer and about 90,000 fry and forage fish escaped into the river.

The experiments indicate that better results can be obtained when the ponds are not overstocked, and that if the brood fish are in good condition much smaller numbers are required than is usually realized. Overcrowding the fry has a tendency to increase cannibalism, with the result that ordinarily less fingerlings survive the summer than is the case when smaller numbers are present at the beginning of the season. Consequently when the fry are to be reared in the same pond with the brood fish only a few pairs of adults are required to the acre. The fecundity of large brood bass is well illustrated by one of the spawning ponds which was stocked with 17 large females and 7 males. These females produced an average of over 6,500 fry each. At this rate 4 females would produce enough fry to stock a rearing pond 1 acre in area. It is of interest to note that our records show that these same females averaged at least 5,500 fry in 1928.

Rearing bass brood stock.—It has also been shown that it is perfectly feasible to rear bass to maturity in small hatchery ponds, and additions to the brood stock at Fairport are limited strictly to fish which have been reared in the station ponds. Each year a few of the best fingerlings are reserved for brood stock, and it is believed that in this way it will be possible to get better fish than by the old method of depending on wild fish for propagation purposes. No difficulty has been experienced in rearing these fish, and during the past season fry were obtained from both 2 and 3 year old fish which had been reared in the station ponds. One lot of 2-year-old bass containing 10 females and 5 males produced an average of over 1,200 fry to each female.

Experiment with smallmouth black bass.—As in 1928, one pond was stocked with 19 smallmouth bass and with adult shiners for forage. The fry were allowed to remain in the pond with the brood fish throughout the summer. When drained on October 1 the pond yielded 6,010 3-inch fingerlings, which was at the rate of approximately 7,000 to the acre. The success attained with smallmouth bass during two successive seasons has been somewhat surprising inasmuch as conditions in the ponds are quite different from those usually considered essential for smallmouth bass.

Propagation of bluegill sunfish and crappie.—Two small ponds devoted to the propagation of bluegill sunfish gave a surprisingly large production so far as numbers are concerned. The production in one pond was at the rate of 136,280 fingerlings per acre. In the second pond the yield was at the rate of 298,280 fingerlings to the acre, but the fish were considerably smaller than in the first pond.

The results with crappie during the season of 1929 were very unsatisfactory, probably largely due to the poor condition of the brood stock.

Fertilizing ponds.—During the past three years the ponds, with few exceptions, have been fertilized with a mixture of superphosphate and dry sheep manure. This fertilizer has given uniformly good results, but during the past year comparative tests with this mixture and soybean meal indicate the superiority of the latter as a fertilizer for fish ponds. Final judgment should be reserved, however, until further tests are made.

INVESTIGATIONS IN THE UPPER MISSISSIPPI WILD LIFE AND FISH REFUGE

The investigations in the Upper Mississippi Wild Life and Fish Refuge, supervised by Dr. H. S. Davis, were continued under the immediate direction of Eugene W. Surber. A number of sloughs in the vicinity of Trempealeau, Wis., were selected for intensive work and most of the activities of the past season centered around these sloughs. They are connected with the river only during periods of extreme high water and appear to afford suitable conditions for the propagation of bass and other game fishes.

Preparation of sloughs for bass culture.—The sloughs selected for experimental work were cleared of brush and coarse vegetation early in the season after which they were seined so as to remove predacious fish, such as pickerel and gar-pike, which might interfere with the propagation of more desirable species. Unfortunately, plans to propagate black bass in the sloughs were not realized owing to the impossibility of obtaining a stock of brood fish. Nevertheless, work on cleaning up the sloughs was continued and several are now ready for stocking early in the spring of 1930. A supply of adult largemouth bass has been obtained for brood stock, and these fish are being wintered in a spring-fed pond at Trempealeau.

Limnological observations.—Although it was found impossible to rear fish in any numbers during the summer of 1929, extended limnological observations were made at regular intervals. These observations are being continued through the winter so there will soon be available detailed information regarding condititions in the sloughs throughout the year. The limnological work includes the collection of samples of the plankton and bottom fauna and determinations of dissolved oxygen, free and fixed carbon dioxide, and alkalinity at 2-week intervals.

Studies of the plankton and bottom organisms have shown that the sloughs are very rich in fish food and are apparently capable of supporting a much larger fish population than is present usually. However, Mr. Surber has found that in most of the sloughs the supply of dissolved oxygen becomes rapidly depleted after they freeze over, and that by the middle of December the oxygen content is below 0.5 parts per million. In several instances fish half dead from asphyxiation came up to the holes that had been chipped in the ice for making the collections. It is evident that under such

FIGURE 8.—Cleaning slough for rearing bass fingerlings in Upper Mississippi River Wild Life and Fish Refuge

conditions very few fish can survive in the sloughs through the winter. Doubtless it is owing to this fact that sloughs which are overflowed only at infrequent intervals usually contain very few fish even though there may be an abundance of food available. These studies indicate that, in general, the small slough fishes eat the food that is most available in their particular environment and exercise little choice or selection. There are, however, numerous exceptions to this rule, especially among the minnows.

CONTROL OF AQUATIC VEGETATION

One of the greatest problems in connection with fish cultural work in the sloughs is the control of aquatic vegetation. Unless the plants are kept within bounds the sloughs become choked with a rank growth of both emergent and submerged aquatics which absolutely prevent the use of a seine and may have an adverse effect on the fish and other animal life. Removal of this excessive plant growth by the usual means is a very laborious process and is also highly objectionable for other reasons. A chemical treatment which will destroy the coarser plants without injury to the fish or serious interference with the food supply would be a great help in utilizing the sloughs for fish propagation.

During the past summer preliminary experiments in treating the sloughs with sodium arsenite gave most encouraging results. It was found that a solution of this chemical when sprayed on the surface of the water in sufficient quantities to produce about 2 parts of arsenic trioxide to a million parts of water caused the destruction of such plants as *Ceratophyllum demersum*, *Potamogeton interior*, *P. foliosus*, *Heteranthera dubia*, and *Elodea canadensis*. The effects of the treatment are apparent within two or three days, when

FIGURE 9.—Installing a Hesen fry trap for the capture of fry from a slough stocked with adult black bass, Upper Mississippi Wild Life and Fish Refuge. The fry are then removed to rearing ponds where they are free from the danger of being eaten by their hungry parents or by other species

the plants sink to the bottom and decay. Of course the decomposition of the plants will remove dissolved oxygen from the water, and there is danger of deficiency of this gas when the treatment is administered to dense vegetation. In only one case was there any evidence that the fish were injured by the treatment and in this instance, owing to the large amount of vegetation present, the use of the weed killer was followed by a marked oxygen deficiency.

Plankton and bottom samples were collected in ponds treated with sodium arsenite, but the study of these has not yet been completed. However, some preliminary examinations of the collections indicate that some of the plankton organisms increased and others decreased as a result of the treatment.

Recently Dr. A. H. Wiebe has conducted a series of experiments at the Fairport station on the effects of arsenic on fish in aquaria.

Largemouth black bass, crappie, bluegill sunfish, bullheads, and goldfish were used in these experiments, and it was found that the fish were not injured appreciably by a concentration of arsenic trioxide as high as 7 parts per million. Since the fish were kept in these high concentrations of arsenic for several days without injury, it is apparent that no danger to the fish need be anticipated from the use of arsenic in concentrations sufficient to kill vegetation.

OYSTER INVESTIGATIONS

Oyster investigations carried out under the direction of Dr. Paul S. Galtsoff during 1929 consisted in the experimental study of oyster culture in New England, Georgia, Texas, and Washington; in a study of the physiology of adult and larval oysters; in the survey of the oyster bottoms of the States of Alabama and Delaware; in a study of the effect of pulp-mill wastes on oysters in Puget Sound; and in an investigation of the biology of the natural enemies of the oyster—the oyster drill and the starfish.

EXPERIMENTAL STUDIES IN OYSTER CULTURE

NEW TYPE OF SEED-OYSTER COLLECTOR

Experiments carried out by H. F. Prytherch in cooperation with the Bluepoints Co. and the Connecticut Oyster Farms Co. have resulted in the development of a practical and efficient method for collecting and transplanting heavy or intensive oyster sets.

In certain oyster-growing regions, such as South Bay, Long Island, and the tidal flats in the South Atlantic States, the setting of oysters is often so intensive that a high percentage of the spat die from overcrowding, lack of oxygen, food, etc.; and those surviving are so closely cemented together and misshapen as to be of little value as seed oysters. A cheap collector for use under such circumstances was devised by Prytherch in 1923, consisting of cardboard egg-crate partitions which were covered with either paraffin and coarse sand or asphalt. The final step in perfecting this type of collector and making it of practical value is credited to W. H. Raye, president of the North Atlantic Oyster Farms, who used a coating of lime, cement, and sand which has improved the collector in many respects. By covering the cardboard with this mixture, we have essentially a series of compartments lined with a thin layer of shell-like substance which has been found suitable for collecting thousands of spat and holding them until they are large enough to be broken apart and separated as single seed oysters.

During the past summer 2,000 set collectors of this general type were tested out in South Bay, Long Island, and Milford Harbor, Conn. The size of the collector was increased so as to consist of 25 compartments giving a total of approximately 1,000 square inches of surface per collector. In South Bay the setting was quite heavy and covered almost every collector with from 50 to 200 spat per square inch of surface. By comparing the growth and survival of spat on the partition collectors with those attached to oyster shells on the same area, the superior value and efficiency of the new method can be seen.

On a single oyster shell having an average of approximately 20 square inches of surface, there rarely can be produced more than 25 or 30 year-old seed oysters, regardless of whether the original set numbered 100 or 1,000 spat per shell. However, the same amount of surface on the partition collector is capable of producing from 200 to 400 seed oysters, or approximately 15 times as many per square inch as can be grown on the shells.

With a set averaging 50 spat per square inch, as was obtained in South Bay, there is a loss of over 98 per cent on the shells and only 70 per cent on the collectors. A single representative collector taken from South Bay in September yielded by actual count 13 200 single seed oysters or the equivalent of what could be produced on a bushel of shells. By separating the seed oysters from the collectors when

FIGURE 10.—Cardboard seed oyster collectors, developed by bureau investigators, showing 1930 set in Long Island Sound

they are a few months old it is possible to get a much larger and better shaped year-old oyster than can be grown from sets obtained on shells.

The new type collector can be planted directly over the shells and will greatly increase the productivity of such oyster-setting bottoms.

NEW ENGLAND

Studies in oyster culture in New England, carried out by H. F. Prytherch, were conducted from the headquarters established at Milford, Conn., and extended to Long Island Sound and Great South Bay, N. Y.

Spawning and setting of oysters in Long Island Sound.—Since the production of seed oysters in Long Island Sound has been shown by previous investigations to depend largely upon climatological and hydrographic conditions in this region, it became evident that additional records and observations would have to be made each year to assist the industry in its oyster cultural operations and to increase our knowledge and understanding of the controlling factors. For this purpose, several cruises were made in cooperation with the State Shellfish Commission of Connecticut and the Connecticut Oyster Farms Co. to secure data as to the temperature and salinity of the water, the abundance of adult oysters, and especially the quantity of spawn which they had developed. The average air temperature during the spring and early summer months was 4.3° F. above normal, and could be correlated as in previous similar years with the production of a large quantity of eggs in the reproductive organs of the oyster. The summer was exceptional, however, in two respects; that is, the discharge of fresh water from the rivers into Long Island Sound was the lowest that it had been in several decades, and the spawning and setting of oysters was over a month later than usual. Water temperatures were favorable for oyster spawning the latter part of July, which is the usual time; but this event did not take place until nearly the middle of August, when the salinity was reduced by heavy rains on August 11 and 12. The development and setting of the oyster larvæ was also greatly retarded and covered a period of over 30 days, which is twice as long as any that had been recorded previously.

A cruise was made from New Haven Harbor to Black Rock Harbor for the examination of shell plantings, which showed that a light set had occurred on September 14 to 18 and that it was widely distributed over both inshore and offshore beds.

GEORGIA

In April Dr. R. H. Luce, temporary assistant, made hydrographical observations in tidal rivers near Doboy Island, and collected and examined the spat collectors (brush) which were planted there in the summer of 1928. These observations have shown that oak brush may be used as an excellent spat collector and that the catch of oysters on the larger pieces of brush (3 to 6 centimeters, 1¼ to 2½ inches, in diameter) was decidedly better than on the smaller branches and twigs. Of the brush planted in three different localities in the Doboy Island region, one planting (Duplin River) was very successful, one (North River) failed completely to catch oysters, while the third one (Doboy Island) caught but a small number of spat. An analysis of hydrographical conditions shows that the failure of plantings of 1928 in North River and Doboy Island can hardly be attributed to any other factor than the unusual amount of fresh water in this region from the middle of August through September. The success of the Duplin River brush may be attributed to the fact that this river is a "dead" river, in that it ends in salt marsh and has no supply of fresh water at its head, so that the freshet of August, 1928, probably did not affect it.

TEXAS

In cooperation with the State Game, Fish, and Oyster Commission of Texas, Dr. A. E. Hopkins made, during the spring and summer, an extensive study of the influence of hydrographic conditions upon the oysters in the bay waters near Galveston. The investigations centered in a field laboratory on Offats Bayou, an arm of the West Bay portion of Galveston Bay. Water temperatures and salinity records were made daily near the laboratory and frequently at other places throughout the bay.

Spawning.—The oysters started spawning at the end of March, at a temperature of about 25° C. (77° F.), and larvæ became extremely abundant in the water especially during the following two months. A fairly exact estimate of intensity of spawning was obtained by townet collections of free-swimming larvæ. The time and abundance of setting was determined by planting wire bags filled with shells in favorable locations. These were brought to the laboratory periodically for examination. The period of spawning near Galveston lasted from the end of March until at least September 1, and probably continued for another month, for the oysters still contained spawn. The bulk of the spawning, however, occurred in April, May, and June.

Setting.—Considerable evidence was obtained to show that the salinity of the water is a controlling factor in the setting of oyster larvæ in this region. Although the water may be well populated with oyster larvæ, they will not attain the setting stage unless the water contains 20 to 21 parts of salt per thousand. This is probably why attempts to rehabilitate reefs and establish new ones by planting oyster shells during spring and summer have failed. However, to plant shells when the salinity is high enough should surely succeed, for setting would then occur before the shells could become coated with slime.

Wire bags of shells were planted, and the set obtained proved tne adequacy of this method in Gulf waters. As many as 40,000 spat per bushel of shells were obtained during two weeks at the height of the setting period. Spat grew in the warm water at the rate of about 0.3 millimeter a day in diameter, or 1 inch in two and one-half months.

Salt analyses, Galveston Bay.—With the cooperation of W. B. Wardlow, of the Texas Department of Health, quantitative analyses of the salts in various parts of Galveston Bay were made. The results show a remarkable variation in the proportion of the constituent salts present. Such fluctuations in the salts in solution in sea water may probably be of great importance in the life of the oyster and other organisms. The oyster is highly sensitive to such changes in the water, and its feeding behavior is readily influenced by sudden changes.

WASHINGTON

Investigations in oyster culture in the State of Washington were carried out by H. C. McMillin. Headquarters were established on Totten Inlet (Oyster Bay) in April. Temperature and salinity records were kept throughout the season. Spat collectors were put out in all of the oyster-producing bays on the lower end of Puget Sound and in Willapa Harbor. Plankton samples were taken in the open bay at high tides and in the dikes at low tide.

A careful examination of all the beds of the State was made to discover the presence of forms which had been brought in with the imported Japanese seed oysters. It has been found that the Japanese drill occurs in restricted areas, while the eastern drill is more generally distributed; up to date it has not affected the principal centers of oyster production. About 20 other species of Japanese forms have been introduced in Puget Sound and many of them thrive, becoming potential sources of danger.

PHYSIOLOGY OF ADULT AND LARVAL OYSTERS

Temperature effect on feeding of Gulf coast and Japanese oysters.—Dr. P. S. Galtsoff continued a study of the physiology of feeding and spawning of oysters. Several experiments on the effect of temperature on the rate of feeding were carried out in April at the temporary laboratory established at Offats Bayou, near Galveston, Tex. It has been found that similar to the behavior of oysters from Cape Cod and Long Island Sound, the oysters from the vicinity of Galveston Bay respond to the changes in temperature in the same manner as those growing in the northern waters. The rate of feeding increases with the increase of temperature, reaching the maximum at about 30° C. (86° F.) Cessation of feeding occurs at the temperature between 7° and 9.5° C. (45° and 49° F.); that is, at the same temperature which causes the cessation of feeding in northern oysters. The conclusion seems inevitable that the warm waters of the Gulf of Mexico fail to produce any physiological changes in the ciliary mechanism of the gills. A study of the effect of temperature on the feeding of Olympia (Wash.) oysters (*Ostrea lurida*) and the Japanese oyster (*Ostrea gigas*) was made at the Jacques Loeb laboratory of Hopkins Marine Station, Pacific Grove, Calif. The maximum rate of feeding of the Japanese oyster (4 liters, or approximately 1 gallon, per hour) occurs at the temperature of 25° C. (77° F.); the optimum temperature for feeding of the Olympia oyster is between 25° and 30° C. The highest rate of feeding of the Olympia oyster is between 500 and 600 cubic centimeters (approximately 1 to 1½ pints) per hour. Japanese oysters cease feeding at the temperature of 6° to 7° C. (43° to 45° F.); Olympia oysters stop feeding at the temperature of 8° to 10° C. (46° to 50° F.).

Factors which affect spawning.—A study of spawning of oysters has been continued and experimental work was carried out at Woods Hole, Mass., Galveston, Tex., and Pacific Grove, Calif. The experiments were undertaken for the purpose of determining the factors which control the discharge of the sex products of the female and male oysters. The results obtained during last year confirm the conclusions previously reached and reported in the annual reports for 1927 and 1928, and add some new facts which were unnoticed in previous experiments. It has been observed during the experiments at Woods Hole that the spawning of male oysters can be stimulated not only by the addition of eggs or egg water, but also by the addition of the sperm. In the latter case, the latent period of the reaction—that is, time elapsed between the addition of sperm and the beginning of the reaction—is about 10 minutes, the same duration as in the case of stimulation of the female by sperm. Since the active principle of the sperm suspension does not pass through collodion membrane and is probably located in the body of the spermatozoa, the hypothesis was advanced that it acts upon oysters through the digestive tract. Indirect evidence in support of this view is found in the fact that particles suspended in the water surrounding the gills reach the stomach in about 10 minutes. Experiments carried out with Japanese oysters supported all the findings made in the experiments with the eastern species. The only difference was that the critical temperature below which spawning of the Japanese oyster does not occur, is 25° C. (77° F.) instead of 20° C. (60° F.) as has been determined for the American species; and that without the addition of sperm a temperature of 30° C. (86° F.) instead of 27° C. (81° F.) induces spawning of the Japanese oyster. The males of *Ostrea gigas* respond to the addition of eggs even at a temperature of 10° C. (50° F.). Since the temperature of Puget Sound rarely reaches 15° C. the failure of this species to propagate here is explained.

Potential fecundity of oysters.—The potential fecundity of oysters—that is, the number of eggs developed by the female—was studied by Dr. Paul S. Galtsoff at Woods Hole laboratory. A female oyster, placed in a glass tank and having an upper valve attached to a recording apparatus, was induced to spawn. After the reaction was finished, the water was vigorously stirred and the number of eggs was enumerated by taking four samples of 100 cubic centimeters of water and counting the eggs in a Sedgwick Rafter camera. It was found that the female, which was 5 inches long and 4 inches wide, discharged 109,000,000 eggs (this figure is correct within 10 per cent). This figure is much higher than all estimates made by previous observers (from 2,000,000 to 60,000,000). When this oyster was dissected, it was found that the gonads were still full of eggs, the thickness of the gonad layer being about 0.7 centimeter. Since previous experiments have shown that one female may spawn 6 or 7 times during the season, the conclusion can be reached that one oyster may produce nearly half a billion eggs.

Effect of temperature on heart beat.—A study of the effect of temperature on heart beat was carried out by H. F. Prytherch at the laboratory of the University of Pennsylvania.

In their natural environment, oysters are subjected to water temperatures ranging from approximately 0° to 30° C. (32° to 86° F.). By observing the heart beat at different temperatures throughout this range, we are able to determine the relative degree of activity of the metabolic and other physiological processes of the organism, such as feeding, respiration, development of the gonads, etc. The average of all these experiments shows clearly that an increase in temperature produces an increase in the rate of beat. The heart beat was observed to stop at low temperatures ranging from 2.5° to 5° C. (36.5° to 41° F.), which supplies further evidence of the hibernation of the oyster during cold weather. The study of heart beat also shows the relative importance of water temperature during the spring and summer months on the growth, development, and ripening of the reproductive products. Since metabolic processes are directly proportional to temperature, it is evident that fluctuations from the normal temperature will have a direct bearing on the oyster industry.

Phenomenon of setting.—A study of the physiology of the oyster larvæ was continued by H. F. Prytherch at Milford, Conn. It was discovered in 1928 that copper salts would produce setting of a fully developed oyster larva, or in other words, cause it to go through the processes necessary for its attachment and metamorphosis. By using extremely minute quantities of this metal, it was possible to obtain for the first time detailed observations and photographs of this important stage in the life history of the oyster.

The setting of the larva is a biological reaction of a most positive character, which occurs in nature under rather definite physical conditions. In Milford Harbor, setting was observed to occur during the period of low slack water, which differs from all other stages of tide in that the salinity and hydrogen-ion concentration of the water are lowest and the temperature highest. In other words, setting occurs at a stage of tide when the effect of river discharge is greatest on the physical condition of the water over the oyster beds. By experiments carried out during the past two summers, it was found that changes in salinity, temperature, oxygen content, and hydrogen-ion concentration would not produce the setting of the larva in a single instance. However, when the salinity was reduced by the addition of river water instead of distilled water, setting took place, which indicated that either some substance or physico-chemical change introduced by river water was responsible for the producing of the setting reaction.

A series of experiments was then undertaken to test the effect of the various chemicals occurring in river water on the setting of the larva. Various concentrations of the chlorides, carbonates, and sulphates of sodium, potassium, calcium, and magnesium gave negative results, as did also sodium nitrate and nitrite and compounds of aluminum, lead, zinc, tin, silver, and iron. The only substance that gave a positive setting reaction was copper in the form of a pure metal or as a carbonate, sulphate, or chloride. Concentrations of 1 part copper to 500,000 or 1,000,000 parts of water were sufficient to produce setting and initiate almost immediately the beginning of the attachment process.

In river water, copper occurs in extremely small amounts and at periods of low slack water there are undoubtedly enough free metal ions to stimulate the larva and cause setting. In water of low salinity (16 per mille) the process of setting required 15 to 30 minutes; while in salinites of 25 to 28 per mille, the larva seemed to experience considerable difficulty in secreting the byssus and cementing fluid and did not become attached for 2 or more hours after exposure to copper ions. This phase of the setting problem will be taken up in greater detail during the coming summer.

The studies thus far show quite conclusively that the copper brought down by the river may become a factor which controls the time and place of attachment of oysters.

SURVEYS OF OYSTER BOTTOMS

Alabama.—In April, 1929, at the request of I. T. Quinn, Alabama State Conservation Commission, Dr. Paul. S. Galtsoff made a survey of the oyster bottoms with the view of determining the extent of the damages to oyster reefs caused by the flood and finding a method for the rehabilitation of the destroyed bottoms. The State conservation department cooperated in this work by providing a suitable boat with equipment and by supplying the necessary labor. The party, consisting of Drs. P. S. Galtsoff, R. H. Luce, State Deputy A. Ackridge, and several members of the "sea food emergency committee of the Mobile Chamber of Commerce" visited all the principal public reefs in Alabama waters and determined the percentage of oysters killed. The destruction of oysters was found to be so extensive that the necessity of immediate rehabilitation of the reefs was self-evident. The percentage of survivors on the reefs of Mobile Bay varied from 0 to 6.6 per cent; 15 per cent of the oysters survived at Grants Pass. The oysters on the principal reefs in Alabama waters (White House, Cedar Point, Grants Pass) were

FIGURE 11.—Oyster fleet, Delaware Bay

either completely destroyed or their number was so reduced that the reefs can not become productive unless they are rehabilitated by the planting of new stock. Oysters along the southern shore of Mississippi Sound were not affected by the flood

The following recommendations for the rehabilitation of the destroyed oyster bottoms were made: (1) Establish spawning beds; (2) plant cultch (shells) in the immediate vicinity of the spawning beds; (3) restock the reefs with seed oysters; and (4) during the rehabilitation period, the reefs should be closed to all oyster fishing and efficiently patrolled.

Delaware Bay.—From September 1 to the latter part of November, a survey of the oyster industry of New Jersey and Delaware in Delaware Bay was made by W. H. Dumont. The area of natural beds producing seed oysters is approximately 8,000 acres in New Jersey and 400 acres in Delaware. Comparing these figures with the data for 1910–11, it is found that this is an increase of about 15 per cent for the New Jersey side and a decrease of about 50 per cent for Delaware. The planted bottom under lease from the States is 29,600 and 6,800 acres, respectively.

Effect of pulp-mill wastes on oysters in Shelton Bay.—In compliance with numerous requests made by the oystermen of Shelton Bay, Wash., a study of the effect of sulphite waste liquor discharged by the pulp mill has been undertaken. A temporary laboratory has been established in one of the floating "oyster houses" in Totten Inlet near Olympia. The work, which was begun in November, 1929, is being carried on by Dr. A. E. Hopkins and H. C. McMillin. A complete report of these investigations will appear at a later date.

CONTROL OF ENEMIES

Starfish.—An investigation for the control and elimination of starfish on oyster beds in Long Island Sound, N. Y., where it is the most serious natural enemy of the oyster, was carried out from June to September by Miss Louise Palmer. The life history and growth of the animal were studied, and a series of experiments was carried out to ascertain the susceptibility of starfish of different ages to various chemical substances. It has been found that starfish of Cold Spring Harbor, Long Island, spawn the first and second weeks of July and set on the grass and shells the first or second week of August. The spawning temperature varies from 23.5° to 26° C. (74° to 79° F.).

The minute stars are very destructive to the newly set oysters, and consequently are objects of special consideration for eradication. Unfortunately, starfish are not very sensitive to environmental changes or the presence of toxic substances. It has been found, however, that concentrations of copper sulphate from 20 to 150 parts per million, while not affecting young oysters are very effective in killing starfish. This effect is not dependent on temperature. The study of the methods of controlling starfish will be continued, and it is hoped that a practical solution of the problem will be found.

The oyster drill.—A study of the biology of the oyster drill, carried on at Beaufort, N. C., by Dr. Henry Federighi since 1926, has been completed, and the report was submitted for publication. The results of this investigation made possible the recommendation of certain measures to control this destructive species, some of which had already been mentioned in previous reports. A new method of catching drills has been developed and successfully tested at Beaufort. It consists in using small concrete pillars, which are placed on the infested oyster bottom. Because of the tendency of the drills to creep upward, the animals gather on the pillars and are then taken out and destroyed. Pillars of the size of 12 by 10 inches have collected as many as 500 drills in 3 days.

FRESH-WATER MUSSEL INVESTIGATIONS

Mussel culture.—The new system of mussel culture worked out for the bureau by Dr. M. M. Ellis at the Fairport station during the summer season, and at the University of Missouri under the supervision of the bureau during the college year, has made the advances outlined for it in last year's annual report. It was then stated that particular attention would be given to developing individual mussel culture units to handle a greater number of glochidia at a time. The capacity of these units has been tripled in the course of the last six months, so that each unit will now handle one and one-half million at a time. Several such units have been operated to capacity, several times producing some five or six million young mussels in the course of the summer and fall. These were held sufficiently long to determine that they were normal and healthy. Then at intervals portions of them were analyzed to determine proportions of essential chemicals at the various periods.

The young mussels actually produced in the few mussel culture units used were sufficiently great in number to warrant the assumption that the large-scale production of mussels is established as economically feasible. Two million of the young mussels produced at Fairport were removed to the University of Missouri by car, where they arrived in perfect condition. This made certain that young mussels may be transported safely to streams for planting.

Further experiments at the university regarding this last problem have shown that transportation may be made with maximum success during the first three days after completion of metamorphosis from the glochidial stage, or after a period of three weeks from this date.

Mussel surveys.—During the summer of 1929 considerable attention was given to the problem of determining chemical requirements of waters suitable for the planting of mussels. A trip was made by Doctor Ellis and Mr. Chamberlain to mussel waters of Arkansas, Louisiana, Texas, and Mexico where many waters were examined ranging from some very decidedly alkaline to others distinctly acid. Notes were also made of the mussel fauna, if any, present in each. At the same time the mussel resources of the Rio Grande Valley, on both sides of the international boundary, were given a hurried survey.

Texas has not had a reputation in the past as a mussel-producing State, but as a result of the increased cost of commercial mussel shells during the past few years, it has proved economic to ship shells to the pearl button manufacturing centers in the Middle West and in the East. As a result the mussel resources of Florida and of Texas, but particularly of the latter, have been given increased attention during the past two years. The hundreds of miles of irrigation canals built in the citrus section of the lower Rio Grande Valley were found to contain an extensive supply of mussels of commercial value. In addition several rivers in Texas have produced many carloads of shells during the past year.

Depletion.—The evidence of further mussel depletion in most of the heavily worked mussel waters of the country during the past year has been striking. A survey during the past summer of the formerly productive Lake Pepin, between Minnesota and Wisconsin, has shown a pronounced decline in mussel population.

The same depletion has been evident in many mussel waters with the result that the price of raw material has most seriously mounted. How far the newly developed mussel territory in Texas and Florida will meet the deficiency is not yet known. Some effort to meet the deficiency by importing fresh-water mussel shells is being made. A small number of tons of Chinese shells have been imported. Mexican resources are being looked into. Two companies are sending representatives to South America. Canada has mussels of commercial value but so far permits only the most limited and restricted shelling for domestic use only. Siamese shell resources are being examined by Dr. H. M. Smith, adviser in fisheries to the Siamese Government.

The most cordial cooperation in the bureau's mussel work has been extended by the various State departments. All are ready to assist to the utmost when the bureau's new mussel culture system is definitely started on large-scale production. This assistance will be both the closing of more mussel territory to protect the planting of young mussels and the furnishing of stock mussels for the actual propagation work.

PROPAGATION AND DISTRIBUTION OF FOOD FISHES, FISCAL YEAR 1930[1]

By Glen C. Leach, *Chief, Division of Fish Culture*

CONTENTS

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[1]Appendix XVI to the Report of the U. S. Commissioner of Fisheries for 1930. B. F. Doc. 1098. Submitted for publication Oct. 27, 1930.

INTRODUCTION

It is gratifying to report an all-time high record for the distribution of fish and eggs from the hatcheries operated by the division of fish culture during the fiscal year 1930. The division submits this report with the full knowledge that a detailed analysis of the various items comprising this huge total is necessary to present properly a picture of the real significance of the operations.

The popular conception of the bureau's fish-cultural work, based only upon a limited knowledge of the game-fish hatcheries in the interior and the distribution of these species on private applications, must be overcome. It is essential to make the fact known that the bureau's fish-cultural activities are not alone designated for the benefit of the angler and the casual fisherman but also for the purpose of furthering an important industry and for augmenting the food supply of the Nation.

When the analysis of the distribution records shows an output of over 6,000,000,000 cod, haddock, pollock, flounder, mackerel, etc., the question may arise as to the utility of this activity. It should be borne in mind that the three marine stations propagating these forms are operating at a negligible cost, not greatly in excess of the cost of buying the trout food utilized at the game-fish hatcheries. Again, in considering items of over 150,000,000 each of whitefish and pike perch the fact should be kept clearly in view that the stations in the Great Lakes area propagating these forms also are propagating other commercial forms as well as large numbers of game fish, particularly trout, during a period of the year. It has been stated in previous reports that no definite evaluation of the results attained from the operation of Federal hatcheries is possible. During the past year the passage by Congress of a 5-year expansion program, with over 30 items providing for the expansion of existing fish-cultural activities or the establishment of new ones, is an indication of the conviction of that body relative to the value of Federal fish-cultural work. Such conviction on the part of Congress is, of course, to a great extent, a reflection of the sentiment and viewpoint of the country at large, which viewpoint is further attested by the constantly increasing flood of applications for game fish.

Part 1.—FISH PRODUCTION: PROPAGATION AND RESCUE WORK

SPECIES HANDLED

There is practically no fish sought by the anglers which is not propagated at some of the bureau's hatcheries. The list of commercial species propagated comprises practically all forms whose characteristics are such that they are amenable to methods of artificial propagation. The list appearing below includes 44 varieties.

Catfishes (Siluridæ):
- Catfishes (Leptops sp.).
- Horned pout (*Ameiurus nebulosus*).

Suckers (Catostomidæ): Buffalofish (Ictiobus sp.) and suckers (Catostomus sp.).

Carp (Cyprinidæ):
- Common carp (*Cyprinus carpio*).
- Goldfish (*Carassius auratus*).

Shad and Herring (Clupeidæ):
- Shad (*Alosa sapidissima*).
- Glut herring (*Pomolobus æstivalis*).

Salmons, Trouts, and Whitefishes (Salmonidæ):
- Common whitefish (Coregonus sp.).
- Cisco (*Argyrosomus artedi*).
- Chinook, king, or quinnat salmon (*Oncorhynchus tschawytscha*).
- Chum salmon (*Oncorhynchus keta*).
- Humpback salmon, pink salmon (*Oncorhynchus gorbuscha*).
- Silver salmon, coho salmon (*Oncorhynchus kisutch*).
- Sockeye, blueback, or red salmon (*Oncorhynchus nerka*).
- Steelhead salmon (*Salmo gairdneri*).
- Atlantic salmon (*Salmo salar*).
- Landlocked salmon (*Salmo sebago*).
- Rainbow trout (*Salmo shasta*).
- Golden trout (*Salmo roosevelti*).
- Black-spotted trout, redthroat trout (*Salmo lewisi*).
- Loch Leven trout (*Salmo levenensis*).
- Lake trout, Mackinaw trout (*Christovomer namaycush*).
- Brook trout (*Salvelinus fontinalis*).

Graylings (Thymallidæ): Montana grayling (*Thymallus montanus*).

Pikes (Esocidæ): Common pickerel (*Esox lucius*).

Sunfishes, Black Basses, and Crappies (Centrarchidæ):
- Crappie (*Pomoxis annularis* and *P. sparoides*).
- Largemouth black bass (*Micropterus salmoides*).
- Smallmouth black bass (*Micropterus dolomieu*).
- Rock bass (*Ambloplites rupestris*).
- Warmouth bass, goggle-eye (*Chaenobryttus gulosus*).
- Green sunfish (*Apomotis cyanellus*).
- Bluegill sunfish (*Lepomis incisor*).
- Common sunfish (*Eupomotis gibbosus*).
- Rio Grande perch (*Herichthys cyanoguttatus*).

Perches (Percidæ):
- Pike perch (*Stizostedion vitreum*).
- Yellow perch, ringed perch (*Perca flavescens*).

Striped Basses (Serranidæ): White bass (*Roccus chrysops*).

Drums (Scianidæ): Fresh-water drum, lake sheepshead (*Aplodinotus grunniens*).

Cods (Gadidæ):
- Cod (*Gadus callarias*).
- Haddock (*Melanogrammus æglefinus*).
- Pollock (*Pollachius virens*).

Flounders (Pleuronectidæ): Winter flounder, American flatfish (*Pseudopleuronectes americanus*).

Mackerel (Scombridæ): Common mackerel (*Scomber scombrus*).

OUTPUT

The division has been able to exceed all former records of the distribution of fish and eggs by a total of 500,000,000. It is probable that the feature of greatest popular interest in considering this total, is the fact that over 205,000,000 of the forms distributed belong to the game species and represent about 2.7 per cent of the total, 1.7 per cent greater than the figures for 1929 and identical with those for 1928. The marine species, including eggs and fry, account for the major portion of the huge total with a percentage of 85.9. Six and nine-tenths per cent comprise species of the interior waters which, in addition to supporting market fisheries, are likewise sought to a considerable extent by sportsmen, particularly in the case of the pike perch, lake or Mackinaw trout, and yellow perch. Commercial anadromous forms comprise 4 per cent of the total. The above ratios are substantially the same as those which have existed during the past few years, indicating that the numerical increases in output are distributed quite equitably among the various fields of activity. After a drop during the previous year, the fingerling production was again raised to a point above 250,000,000. This is sufficient to include virtually all the game fishes and large numbers of other forms, particularly the Pacific salmons, which are amenable to artificial feeding and rearing in nursery or hatchery ponds.

Summary, by species, of the output of fish and fish eggs during the fiscal year ended June 30, 1930

Species	Eggs	Fry	Fingerlings	Total
Catfish			86,422,900	86,422,900
Buffalofish	35,613,000		1,376,300	36,989,300
Common sucker	6,750,000			6,750,000
Carp	95,375,000	2,600,000	4,388,100	102,363,100
Shad		4,813,000		4,813,000
Glut herring		10,000,000		10,000,000
Whitefish	6,450,000	146,815,000		153,265,000
Cisco		33,950,000		33,950,000
Chinook salmon	2,310,000	1,585,000	20,971,200	24,866,200
Chum salmon	250,000	23,791,000	403,000	24,444,000
Silver salmon	828,000	4,838,000	2,091,000	7,757,000
Sockeye salmon	4,667,000	6,430,000	20,182,300	31,279,300
Humpback salmon	1,021,000	5,227,000	54,400	6,302,400
Steelhead salmon	2,490,000	795,000	4,485,300	7,770,300
Atlantic salmon	755,000		106,400	861,400
Landlocked salmon	35,000	80,000	845,800	960,800
Rainbow trout	5,688,000		7,216,200	12,904,200
Golden trout			10,000	10,000
Black-spotted trout	6,818,000	55,000	9,584,100	16,457,100
Loch Leven trout	10,896,000	2,149,000	2,930,000	15,975,000
Lake trout	415,000	30,093,000	680,500	31,188,500
Brook trout	500,000	2,353,000	14,046,600	16,899,600
Grayling		1,000,000		1,000,000
Smelt	12,000,000			12,000,000
Pike and pickerel			451,000	451,000
Mackerel		16,502,000		16,502,000
Crappie			19,436,400	19,436,400
Largemouth black bass		1,280,000	1,898,400	3,178,400
Smallmouth black bass		480,000	52,500	532,500
Rock bass			94,500	94,500
Warmouth bass			34,300	34,300
Sunfish			30,499,000	30,499,000
Pike perch	24,850,000	141,515,000		166,365,000
Yellow perch	53,700,000	117,685,000	2,661,500	174,046,500
White bass			285,500	285,500
Rio Grande perch			5,800	5,800
Fresh-water drum			2,400	2,400
Cod	2,055,034,000	229,769,000		2,284,803,000
Haddock	220,344,000	36,416,000		256,760,000
Pollock		616,713,000		616,713,000
Winter flounder	6,692,000	3,329,897,000		3,336,589,000
Miscellaneous fishes			18,954,900	18,954,900
Total	2,553,481,000	4,766,831,000	250,170,300	7,570,482,300

COOPERATION WITH OTHER CONSERVATION AGENCIES

It is obvious that with the various States carrying on fish-cultural work of the magnitude indicated in the tabulations following later, there must be a considerable degree of cooperation and coordination with the Bureau of Fisheries to avoid duplication, overlapping, and waste energy. Practical methods of cooperation with these factors in mind have been and are constantly being developed throughout the country. In many cases there is a joint use of hatchery equipment to take care of the surplus fry at Federal or State hatcheries. Loaning of the bureau's equipment, such as distribution cars, or the services of its experienced men, has been a prolific source of benefit. The instances cited below are given merely as an example and do not constitute an attempt to list all of the cooperative measures that have been in effect with the States.

The bureau has continued the detail of the superintendent of its Arkansas station to supervise the construction of the new State hatchery at Lonoke. Ultimately this will be one of the largest bass hatcheries in the country. Financial aid and the assistance of the bureau's employees were rendered in connection with the efforts of the fisheries authorities of South Carolina to develop the propagation of shad in that State. The bureau assigned a much larger percentage than formerly of the Atlantic salmon eggs received from Canada to the State hatcheries in Maine, with the view of obtaining greater facilities for rearing these fish to the large fingerling size before distribution. The bureau developed joint spawn-taking operations at Pyramid Lake, Nev., taking over the work when the State was forced out. Among the hatcheries operated on a joint basis were those for pike perch on Lake Champlain and the large bass pond recently constructed at Miles City, Mont. A similar joint activity was maintained with the State of Minnesota in connection with the collection and incubation of pike-perch eggs.

High appreciation must again be expressed for the valuable aid rendered by the State of Michigan in the propagation of the commercial species of the Great Lakes. The bureau has endeavored to give further assistance to the State of Virginia in the development of its fish-cultural program by assigning fish to nursery projects. The facilities of the White Sulphur Springs (W. Va.) station have again been available to the State of West Virginia for hatching fish for rearing at its various field stations. Much of the success attained on the Pacific coast is due to close contact and ready assistance available from the States of Oregon and Washington. A clearer picture of the assistance the bureau has been able to render in the assignment of eggs will follow in a table showing the shipment of eggs to the various States.

The activities of the division of fish culture impinge to a certain extent upon the work of practically all of the other Federal conservation agencies. Contact with the National Park Service is based on the bureau's operation of hatcheries exclusively for the restocking of national park waters. The extensive demand for trout and other species for maintaining good fishing in those other extensive recreation areas, the national forests, necessitates a close liaison with the Forest Service. A conference was held with representatives of that agency during the year and a definite program outlining stocking requirements in the national forests throughout the country was submitted to the bureau. The growing importance of irrigation reservoirs and similar reclamation projects, both as fishing areas and as field stations for the collection of eggs from wild fish, brings the bureau in increasingly close contact with the Reclamation Service. The new fish-cultural plant which has been under construction during the past two years at Yellowstone Park will be ready for operation shortly after the close of the fiscal year. The bureau has appointed a district supervisor for the Rocky Mountain region and the greater part of his duties will be to work with national forest and national park officers in the improvement of fishing conditions in those areas.

COOPERATIVE FISH NURSERIES

The cooperative fish-rearing program contemplates the unification of the efforts of the bureau and private sportsmen's organizations in the production of larger fish, and has now been developed to the point where it is one of the routine activities of the division. It has been amply demonstrated that sportsmen's groups can take small fish from the Federal hatcheries and rear them to large fingerling or legal size in nursery pools or ponds constructed, maintained, and operated by themselves, with a reasonable degree of success. The overcrowding of the bureau's facilities at the hatcheries is largely overcome by this means, and the sportsmen are in position to determine by their own efforts the size to which fish are to be reared before planting in their streams.

At the outset the program was developed with the provision that the bureau retain 50 per cent of the output of these nurseries for meeting its own applications. While this provision is still retained in the agreement with the sportmen's groups, in practically no case has the bureau exercised its rights. The total of 125 nurseries in operation this year represents only a limited increase over last year's list. The assignment of fish, slightly in excess of 4,000,000, represents a decrease of almost 1,000,000 below the numbers furnished during 1929. The decline is largely accounted for by the cessation of trout work at the Harrisburg (Pa.) cooperative hatchery, which utilized over 350,000 fish and eggs during the previous year, and a reduction from 800,000 to 245,000 in the number of lake-trout fry reared at the Rogers City nursery in Michigan. The bureau is also exercising greater care in passing on the requests of the nursery sponsors for increased assignments since in many cases the granting of larger allotments would overstock the available facilities and jeopardize the entire output.

In view of the fact that the demands for fish nurseries are straining the bureau's resources, greater care is also exercised in scrutinizing the sites for new nurseries, thereby making the annual increment considerably less than was the case during the first two or three years of development. Fully as many nursery sites have been rejected, due to unsuitable conditions, as have been accepted during the year. A glance at the following table shows that a majority of the establishments are grouped in three States in which the work has been particularly successful. It is hoped that further expansion will be in the direction of additional nurseries in new territory and in the nature of more bass nurseries, the demand for which is pressing. The securing of a proper site for a bass nursery is more difficult, however, and its development may involve considerable expense, although the actual maintenance is much lower than is the case with trout.

At the close of the year unprecedented drought conditions in a few sections were causing concern as to the permanence of the water supply. Reports of fishing in locations where the nurseries have been in operation for two or more years have shown that the work is reflected in much more satisfactory angling conditions. The output of many of the State hatcheries is allotted likewise to rearing pools supervised by the State officials with equally satisfactory results.

Cooperative nurseries and rearing ponds supervised by the bureau in 1930

Locality	Number of fish supplied	Kind
Massachusetts:		
Lowell	10,000	Brook trout.
Pittsfield	27,500	Do.
Michigan:		
Clare	115,000	Do.
Highland	10,000	Do.
Turtle Lake	186,000	Do.
Do	4,500	Landlocked salmon.
Rogers City	245,000	Lake trout.
Minnesota:		
Anoka	5,000	Brook trout.
Kimball	6,500	Do.
Lake City	20,000	Do.
Mora	6,000	Do.
Northfield	5,000	Rainbow trout.
Red Wing	16,000	Loch Leven trout.
Rochester	90,000	Rainbow trout.
Hokah	5,000	Brook trout.
Rushford	20,000	Rainbow trout.
St. Charles	15,000	Do.
Wadena	5,000	Brook trout.
Winona	20,000	Loch Leven trout.
Do	20,000	Do.
Do	15,000	Do.
Do	5,000	Brook trout.
Do	20,000	Do.
Do	3,000	Do.
Missouri: Joplin	34,000	Black bass.
New Hampshire:		
Claremont	5,000	Brook trout.
Dublin	15,000	Do.
Greenville	10,000	Do.
Hocksett	10,000	Do.
Lebanon	20,000	Do.
Merrimack	10,000	Do.
Peterboro	10,000	Do.
Wilton	10,000	Do.
New Jersey: Paterson	10,000	Do.
New York:		
Adams	10,000	Do.
Arena	10,000	Loch Leven trout.
Austerlitz	4,000	Brook trout.
Barneveld	273,962	Do.
Do	88,620	Rainbow trout.
Do	148,230	Brook trout eggs.
Do	75,000	Rainbow trout eggs.
Do	30,000	Loch Leven trout eggs.
Malone	71,000	Brook trout.
Do	15,000	Loch Leven trout.
Oneonta	105,000	Brook trout.
Do	12,000	Loch Leven trout.
Watertown	110,000	Brook trout.

Cooperative nurseries and rearing ponds supervised by the bureau in 1930—Continued

Locality	Number of fish supplied	Kind
Pennsylvania:		
Altoona	15,000	Brook trout.
Do	15,300	Rainbow trout.
Do	10,000	Loch Leven trout.
Analomink	10,000	Do.
Bellefonte	25,000	Brook trout.
Belleville	19,800	Rainbow trout.
Berwick	20,000	Brook trout.
Bloomsburg	30,000	Do.
Do	10,000	Loch Leven trout.
Boswell	5,000	Brook trout.
Carrolltown	15,000	Loch Leven trout.
Chambersburg	15,000	Brook trout.
Do	15,300	Rainbow trout
Chester	10,000	Do.
Do	10,000	Loch Leven trout.
Clearfield	25,000	Brook trout.
Connellsville	10,000	Do.
Ebensburg	10,000	Do.
Fairmont Springs	15,000	Do.
Galeton	40,200	Do.
Hazleton	10,000	Do.
Do	10,000	Rainbow trout.
Johnsonburg	10,000	Brook trout.
Johnstown	10,500	Do.
Do	9,900	Rainbow trout.
Ligonier	25,200	Brook trout.
Do	24,900	Rainbow trout.
Monaca	50	Black bass.
Muncy	35,000	Brook trout.
Do	25,250	Do.
Do	20,000	Loch Leven trout.
Myersdale	30,000	Brook trout.
Pittston	10,000	Do.
Do	5,000	Loch Leven trout.
Punxsutawney	10,000	Brook trout.
Renovo	40,000	Do.
Ridgway	15,000	Rainbow trout.
Scranton	60,000	Brook trout.
Somerset	25,000	Do.
Do	15,000	Rainbow trout.
Troy	10,000	Brook trout.
Williamsport	20,000	Do.
Do	15,000	Do.
Do	30,000	Loch Leven trout.
Do	50,000	Brook trout.
Windber	360,000	Brook trout eggs.
Vermont:		
Bennington	50,000	Brook trout.
Norton Mills	82,800	Do.
Do	25,000	Lake trout.
Do	40,000	Landlocked salmon.
Virginia:		
Big Stone Gap	20,000	Rainbow trout.
Charlottesville	25	Smallmouth black bass.
Shawsville	15,000	Rainbow trout.
West Virginia:		
Durbin	25,200	Brook trout.
Do	5,000	Rainbow trout.
Wisconsin:		
Altoona	5,000	Do.
Arcadia	15,000	Brook trout.
Athelstane	25,000	Do.
Bay City	5,000	Do.
Black River Falls	12,800	Do.
Boyd	5,000	Do.
Cumberland	9,000	Do.
Darlington	10,000	Loch Leven trout.
Eau Claire	17,500	Rainbow trout.
Do	2,500	Brook trout.
Do	30,000	Rainbow trout.
Ellsworth	36,500	Brook trout.
Do	13,500	Rainbow trout.
Elmwood	3,000	Brook trout.
El Paso	15,000	Do.
Elroy	3,000	Do.
Galesville	20,000	Do.
Gilmanton	5,000	Do.
Goodman	8,000	Do.
Hatley	10,000	Do.
Hazel Green	10,000	Do.
Holmen	8,000	Do.

Cooperative nurseries and rearing ponds supervised by the bureau in 1930—Continued

Locality	Number of fish supplied	Kind
Wisconsin—Continued.		
Independence	17,500	Brook trout.
La Crosse	10,000	Do.
Do	10,000	Loch Leven trout.
Do	11,000	Brook trout.
Laona	27,000	Do.
Madison	10,000	Do.
Do	10,000	Rainbow trout.
Manitowoc	10,000	Do.
Marathon	20,000	Brook trout.
Medford	2,100	Do.
Merrill	18,000	Do.
Monroe	15,000	Do.
Mountain	20,000	Do.
Nekoosa	19,000	Do.
Osseo	6,000	Do.
Park Falls	11,400	Do.
Plum City	6,000	Do.
Do	4,000	Rainbow trout.
Prescott	15,000	Brook trout.
Rothschild	16,200	Do.
Schofield	6,000	Do.
Shullsburg	10,000	Loch Leven trout.
Stanley	20,000	Brook trout.
Stevens Point	20,000	Do.
Do	10,000	Rainbow trout.
Tomahawk	20,000	Brook trout.
Tunnel City	10,000	Do.
Viola	5,000	Rainbow trout.
Viroqua	6,000	Do.
Wausau	16,000	Brook trout.
Do	8,000	Loch Leven trout.
Total	3,883,737	

STATE FISH-CULTURAL ACTIVITIES

Following the plan initiated in 1929, the bureau has again endeavored to collect data on the fish-cultural activities of the States by means of questionnaires. The following tables present this information:

Data on State fish-cultural activities and licenses

State	Number of fishing licenses issued	Fees received from licenses	Number of hatcheries	Number of fish-cultural employees	Expenditures for propagation of fish
Alabama	444	$2,200.00	1	2	$8,430.52
Arizona	34,462	94,844.75	3	5	15,688.95
Arkansas	26,400	62,000.00	1	2	35,000.00
California	229,374	469,442.00	26	115	292,000.00
Colorado	114,538	210,382.75	14	28	65,132.78
Connecticut	42,792	102,874.50	7	12	68,050.74
Delaware	4,334	10,026.50			500.00
Florida	24,602	71,218.30	7	12	41,596.70
Georgia			1	2	6,859.24
Idaho	93,547	200,000.00	11	14	70,000.00
Illinois	385,127	170,455.52	6	6	
Indiana	320,674	307,444.20	5	15	63,998.18
Iowa	175,000	175,000.00	4	6	38,819.83
Kansas	81,299	81,299.00	3	11	38,000.00
Kentucky	60,184		3	8	8,518.36
Louisiana	30,000	30,341.22	3	5	5,520.00
Maine	68,384	97,079.50	12	36	86,182.32
Maryland	14,314	16,525.32	6	2	40,395.62
Massachusetts	121,476	285,383.00	7	11	56,115.18
Michigan	134,965	260,733.00	17	15	400,000.00
Minnesota	397,257	366,418.63	12	29	100,340.09
Missouri	308,689	411,876.00	8	20	45,545.00
Montana	85,878	184,644.00	14	18	68,167.00
Nebraska	173,408	176,572.00	4	18	100,000.00

Data on State fish-cultural activities and licenses—Continued

State	Number of fishing licenses issued	Fees received from licenses	Number of hatcheries	Number of fish-cultural employees	Expenditures for propagation of fish
Nevada	6,748	$10,462.00	3	4	$13,500.00
New Hampshire	74,526	130,780.35	6	17	76,972.17
New Mexico	16,925	137,477.00	6	10	46,566.76
New Jersey	200,052	295,228.35	2	15	86,284.53
New York	607,724	661,891.11	11	164	287,713.69
North Carolina	29,000	45,527.35	5	9	50,000.00
North Dakota	3,429	1,714.50	3	3	5,420.00
Ohio	90,000	92,123.00	15	50	109,662.00
Oklahoma	81,000	81,000.00	5	18	100,000.00
Oregon	78,750	270,345.50	39	135	255,717.18
Pennsylvania	263,633	395,450.00	8	36	192,158.39
Rhode Island	13,438	15,804.10	2	6	22,449.10
South Carolina	1,084	3,252.00	----	----	----
South Dakota	112,209	119,283.00	6	8	43,376.93
Tennessee	----	----	----	----	----
Texas	32,111	32,111.00	7	35	106,000.00
Utah	60,000	150,000.00	8	12	64,000.00
Vermont	60,530	86,859.75	5	15	42,914.92
Virginia	144,215	249,373.50	4	5	30,000.00
Washington	212,790	402,591.50	27	49	151,076.37
West Virginia	189,000	70,000.00	1	6	20,000.00
Wisconsin	85,035	225,566.18	23	33	183,174.00
Wyoming	28,757	51,327.75	8	14	82,000.00
Total	5,318,104	7,314,928.13	369	1,096	3,624,046.55

Output of fish by State hatcheries

State	Trout	Bass	Other game fish	Commercial species	Total
Alabama	----	17,085	146,000	----	163,085
Arizona	3,036,400	5,000	31,000	----	3,072,400
Arkansas	----	500,000	----	----	500,000
California	35,152,075	3,545	65,379	6,269,365	41,490,364
Colorado	27,000,000	----	----	----	27,000,000
Connecticut	618,939	1,634	365,715	206,163,000	207,149,288
Delaware	----	10,000	7,000	----	17,000
Florida	----	1,444,200	200,000	[1] 103,292,000	105,036,200
Georgia	600,000	----	----	----	600,000
Idaho	10,000,000	----	30,000	----	10,030,000
Indiana	----	714,360	8,491,350	----	9,205,710
Iowa	330,124	8,120	55,000,000	----	55,338,244
Kansas	----	200,000	550,000	----	750,000
Kentucky	----	53,814	----	----	53,814
Louisiana	----	221,301	258,000	----	479,301
Maine	5,000,000	3,000	2,000,000	----	7,003,000
Maryland	200,645	57,860	600	841,999,600	842,258,705
Massachusetts	580,736	286,406	721,339	----	1,588,481
Michigan	16,443,642	742,639	70,883,730	133,640,900	221,710,911
Minnesota	5,844,070	168,364	----	468,876,899	474,889,333
Missouri	368,386	262,699	331,283	----	962,368
Montana	26,401,334	284,350	10,646,200	999,000	38,330,884
Nebraska	415,230	314,384	1,371,765	----	2,101,379
Nevada	1,142,750	----	----	----	1,142,750
New Hampshire	4,365,287	----	259,920	75,000,000	79,625,207
New Mexico [2]	3,603,440	14,000	21,500	----	3,638,940
New Jersey	650,182	131,000	----	95,105,450	95,886,632
New York	10,540,725	548,800	93,263,835	932,572,230	1,036,925,590
North Carolina	3,760,000	150,000	----	----	3,910,000
North Dakota	----	----	----	15,000,000	15,000,000
Ohio	----	181,400	1,174,604	190,000,000	191,356,004
Oklahoma	----	924,120	155,750	----	1,079,870
Oregon	22,943,397	491,400	2,351,031	92,912,047	118,697,875
Pennsylvania	749,551	255,905	283,521,028	114,430,000	398,956,484
Rhode Island	22,764	19,000	----	----	41,764
South Dakota	1,367,765	43,550	5,275,967	96,735	6,784,017
Texas	----	873,000	347,250	----	1,220,250
Utah	11,000,000	----	----	----	11,000,000
Vermont	1,800,000	13,275	----	23,700,087	25,513,362
Virginia	15,000	700	25,000,000	----	25,015,700
Washington	28,936,067	----	----	137,478,714	166,414,781
West Virginia	986,500	22,500	----	----	1,009,000
Wisconsin	9,411,855	205,731	302,559,970	30,607,000	342,784,556
Wyoming	8,500,000	----	----	----	8,500,000
Total	241,786,864	9,173,142	865,030,216	3,468,243,027	4,584,233,249

[1] Crayfish (102,660,000)

[2] Data cover 18 months' period.

In consulting these data, recognition should be given to several important considerations. Owing to the fact that the various States do not utilize identical calendar periods for their fiscal years, the figures cited do not cover a specific period but comprise the output for the latest fiscal year for which complete data are available. The period covered may be a fiscal year ending June 30 or at some other date, or it may represent the calendar year ending December 31, 1929. The reports, therefore, are approximate and cover an average aggregate output for the entire country.

Furthermore, direct comparison of the numerical output of the different States should not be made without a clear realization of the fish distribution practices followed. In many of the Eastern States, such as Pennsylvania, Massachusetts, Connecticut, New Jersey, etc., the total output of trout and bass may appear to be limited in comparison with other States. This is due to the fact that the State policy is to distribute large-sized fish approaching legal size; and the above-mentioned States, together with others, may be among the foremost in conservation work and universally recognized as providing excellent angling by virtue of the above-mentioned distribution policy. The figures, therefore, are more useful to enable a comparison of each State's production in contrast to its own efforts in previous years rather than for comparison as between States on a competitive basis.

The aggregate production of 4,584,233,249 represents an increase of over 500,000,000 above the total for last year. The increase appears largely in the output of commercial species, the production of trout having declined from 255,050,612 to 241,786,864. Owing to a different method of tabulation the output of bass can not be compared with that of the previous year. In classifying the various groups, the bureau accepted the allocations to the heads " commercial species " and " other game fishes," as made by the States themselves. For example, in the Great Lakes States the wall-eyed pike may be classified in the former group, while in other States it is considered a game fish. Similar conditions exist with regard to many other species, and the same variety may be listed under either of the two above headings but there will, of course, be no duplication. It is felt that the opinions of the State authorities and the fishermen themselves should determine the group in which any given species should be included rather than any arbitrary conclusion by the bureau.

In view of the very general practice of lumping fishing and hunting licenses together, for residents at least, under the heading of a combination license, it is manifestly impossible to secure definite figures on the actual number of licensed anglers. Data on the issuance of fishing licenses, therefore, cover all classes of licenses which carry, individually or in combination, the privilege of fishing. Not all individuals who took out these licenses did so for the purpose of angling. At the same time, there is a very large number of sport fishermen in many States who are not required to possess a license. Landowners and members of their families constitute a very large group in this category. In some States licenses are required only for angling with artificial lures. The figure 5,318,104, therefore, represents the number of potential anglers only, and has no definite value otherwise. In view of the large numbers exempted from the requirements for license, the actual number of individuals who go fishing is probably considerably in excess of the figure cited. No license data were collected in 1929, therefore, no comparisons are practicable.

The number of hatcheries is 10 greater than was reported last year, and there is an unexplained increase of over 300 employees above the incomplete records obtained in 1929.

Expenditures for the propagation of fish show an increase of almost $1,000,000 in comparison with the previous year. It will be noted that the income from licenses is practically double the amount expended on the propagation of fish. As stated above, however, much of the value attributed to licenses accrues from the hunters, and there is no reason to believe that the anglers are suffering any discrimination when only 50 per cent of the license income is allotted to the rearing and distribution of fish.

The entire summary presents a very encouraging picture of the progress of conservation of fish life by State agencies in the fields of artificial propagation.

SALVAGE OF FOOD FISHES

Weather conditions and rainfall in the upper Mississippi River territory were normal in so far as water levels and consequent necessity for rescue operations were concerned. The result was a season involving the salvage of over 161,000,000 fish, in spite of the fact that activities closed somewhat earlier than usual. Approximately three-tenths of 1 per cent of all fish handled in connection with this activity were distributed to applicants or transferred to waters other than those to which the fish may be considered native. Strict adherence to this policy of minimizing distant shipments of salvaged fish is responsible for the bureau's refusal to furnish many organizations or individuals with carload or full-messenger shipments. The ultimate purpose of the bureau is to produce sufficient fish in seminatural rearing ponds of the Upper Mississippi River Wild Life Refuge and at its new hatcheries to obviate the necessity of removing any fish whatever from the rescue territory.

Number and disposition of fish rescued, fiscal year 1930

Locality and species	Delivered to applicants	Restored to original waters	Total number of fish rescued
All stations:			
Buffalofish	10	1,355,839	1,355,849
Carp		4,388,085	4,388,085
Catfish	59,467	86,256,326	86,315,793
Crappie	64,120	18,792,440	18,856,560
Fresh-water drum		2,357	2,357
Largemouth black bass	180,617	411,271	591,888
Pike and pickerel	626	449,995	450,621
Rock bass	150		150
Sunfish	175,052	28,877,233	29,052,285
White bass	225	284,516	284,741
Yellow perch	42,030	2,602,082	2,644,112
Miscellaneous	5,088	17,407,080	17,412,168
Total	527,385	160,827,224	161,354,609
Summary, by stations:			
Andalusia, Ill		9,432,385	9,432,385
Bellevue, Iowa	37,088	35,662,189	35,699,277
Friar Point, Miss	36,465	5,757,020	5,793,485
Homer, Minn	183,325	22,042,470	22,225,795
La Crosse, Wis	73,870	20,693,380	20,767,250
Lynxville, Wis	61,904	40,539,260	40,601,164
Marquette, Iowa	134,733	26,700,520	26,835,253
Total	527,385	160,827,224	161,354,609

TRANSFERS OF EGGS BETWEEN STATIONS

The following table indicates the extent to which a limited number of stations are called upon to supply eggs for a majority of the bureau's game-fish hatcheries. Some of these establishments are particularly adapted for the propagation of certain species of trout, and it is much more economical to operate them largely as egg-producing units for the stocking of other hatcheries from which actual distribution of the young fish is made. It is also advisable to make frequent interchanges of eggs between stations for the purpose of introducing new blood and new strains into the brood stock at the various hatcheries.

Transfer of eggs between stations, fiscal year 1930

Species	Number of eggs	From—	To—
Atlantic salmon	125,000	Craig Brook, Me	Grand Lake Stream, Me.
Black-spotted trout	753,000	Yellowstone Park, Wyo	Bozeman, Mont.
	793,000	do	Glacier Park, Mont.
	150,000	do	Leadville, Colo.
	200,000	do	Saratoga, Wyo.
	100,000	do	Seattle, Wash.
	95,000	do	Springville, Utah.
Brook trout	250,000	Berkshire, Mass	Cape Vincent, N. Y.
	400,000	Craig Brook, Me	Erwin, Tenn.
	100,000	do	Green Lake, Me.
	75,000	do	Nashua, N. H.
	400,000	do	Wytheville, Va.
	1,100,000	York Pond, N. H	St. Johnsbury, Vt.
	150,000	do	Barneveld, N. Y.
	700,000	do	La Crosse, Wis.
	450,000	do	Nashua, N. H.
	600,000	do	Northville, Mich.
	132,000	Springville, Utah	Bozeman, Mont.
	500,000	do	Saratoga, Wyo.
	252,000	do	Seattle, Wash.
Chinook salmon	600,000	Battle Creek, Calif	Mill Creek, Calif.
	550,000	Big White Salmon, Wash	Clackamas, Oreg.
	1,242,000	Little White Salmon, Wash	Puget Sound stations.
	10,000	Birdsview, Wash	Central station, Washington, D. C.
Chum salmon	250,000	Quilcene, Wash	Springville, Utah.
Cisco	1,000,000	Cape Vincent, N. Y	Central station, Washington, D. C.
Landlocked salmon	10,000	Craig Brook, Me	Northville, Mich.
	200,000	Green Lake, Me	Craig Brook, Me.
Loch Leven trout	236,000	Bozeman, Mont	Cape Vincent, N. Y.
	250,000	do	Crawford, Nebr.
	400,000	do	La Crosse, Wis.
	175,000	do	Spearfish, S. Dak.
	374,000	do	Springville, Utah.
	375,000	do	White Sulphur Springs, W. Va.
	10,256,200	Meadow Creek, Mont	Bozeman, Mont.
Pike perch	2,100,000	Swanton, Vt	Central station, Washington, D. C.
Rainbow trout	247,000	Lost Creek, Wyo	Saratoga, Wyo.
	680,200	Meadow Creek, Mont	Bozeman, Mont.
	975,100	do	Glacier Park, Mont.
	50,000	Salmon, Idaho	Leadville, Colo.
	110,800	Creede, Colo	Do.
	294,300	Manchester, Iowa	La Crosse, Wis.
	75,000	Neosho, Mo	Northville, Mich.
	26,000	do	White Sulphur Springs, W. Va.
	75,000	Bourbon, Mo	Barneveld, N. Y.
	550,000	do	Bozeman, Mont.
	25,000	do	Erwin, Tenn.
	100,000	do	Spearfish, S. Dak.
	185,540	Spearfish, S. Dak	Crawford, Nebr.
Silver salmon	123,320	Quinault, Wash	Birdsview, Wash.
	1,469,664	do	Quilcene, Wash.
	515,000	Baker Lake, Wash	Bridsview, Wash.
Sockeye salmon	100,000	do	Do.
	100,000	Quinault, Wash	Clackamas, Oreg.
	1,000	do	Birdsview, Wash.
	1,028,400	do	Quilcene, Wash.
Steelhead salmon	27,000	Birdsview, Wash	Charlevoix, Mich.
	26,000	do	St. Johnsbury, Vt.
	69,000	Quilcene, Wash	Birdsview, Wash.
	138,000	Sultan, Wash	Do.
	100,000	Applegate Creek, Oreg	Creede, Colo.
	50,000	do	Clackamas, Oreg.
	176,000	do	Rogue River, Oreg.
	50,000	do	St. Johnsbury, Vt.

Assignments of fish eggs to State and Territorial fish commissions, fiscal year 1930

State and species	Number	State and species	Number
California:		New Hampshire: Chinook salmon	75,000
Atlantic salmon	20,000	New Mexico: Loch Leven trout	2,504,000
Loch Leven trout	50,000	New York:	
Steelhead salmon	200,000	Lake trout	240,000
Colorado:		Landlocked salmon	120,000
Lake trout	100,000	North Carolina:	
Loch Leven trout	1,125,000	Loch Leven trout	150,000
Rainbow trout	100,000	Rainbow trout	100,000
Steelhead salmon	350,000	Oregon:	
Connecticut: Loch Leven trout	200,000	Sockeye salmon	4,553,200
Georgia: Rainbow trout	476,000	Steelhead salmon	1,217,000
Hawaii:		Pennsylvania:	
Chinook salmon	25,000	Atlantic salmon	20,000
Steelhead salmon	50,000	Brook trout	400,000
Idaho:		Common sucker	6,750,000
Steelhead salmon	300,000	Pike perch	24,900,000
Whitefish	1,000,000	Rainbow trout	100,000
Maine: Atlantic salmon	535,000	South Dakota: Loch Leven trout	300,000
Maryland:		Utah:	
Loch Leven trout	200,000	Loch Leven trout	270,000
Rainbow trout	200,000	Silver salmon	526,126
Massachusetts: Loch Leven trout	100,000	Vermont:	
Michigan:		Lake trout	25,000
Landlocked salmon	10,000	Landlocked salmon	5,000
Steelhead salmon	50,000	Washington:	
Whitefish	3,200,000	Black-spotted trout	1,525,000
Minnesota: Loch Leven trout	100,000	Humpback salmon	1,021,000
Montana:		Wyoming:	
Loch Leven trout	4,100,000	Black-spotted trout	2,302,000
Rainbow trout	1,112,000	Loch Leven trout	2,125,000
Nevada:		Rainbow trout	308,500
Brook trout	20,000		
Rainbow trout	796,000	Total	63,955,826

SHIPMENTS TO FOREIGN COUNTRIES

The forwarding of less than 2,500,000 trout eggs to four foreign countries during the year represents a decline in this activity. Shipments of eggs to Canada are involved in a transfer arrangement whereby the bureau receives Atlantic salmon eggs. Of especial interest was the shipment of eggs to Chile, which was accompanied by the chief inspector of fisheries of that Government upon his return from an official visit to this country. These shipments are the nucleus of a carefully considered effort to acclimatize desirable food and game fishes from the United States in Chilean waters.

Shipments of fish eggs to foreign countries, fiscal year 1930

Country and species	Number of eggs	Country and species	Number of eggs
Canada:		Chile—Continued.	
Black-spotted trout	500,000	Sockeye salmon	114,000
Loch Leven trout	300,000	Whitefish	250,000
Rainbow trout	500,000	Ecuador: Rainbow trout	100,000
Chile:		Venezuela: Steelhead salmon	100,000
Chinook salmon	200,000		
Lake trout	200,000	Total	2,489,040
Silver salmon	225,040		

OUTPUT OF STATIONS AND SUBSTATIONS

The distributions previously mentioned are obtained from the operation of 37 stations and 48 substations and auxiliaries, some of which are of a purely temporary nature. The latter are operated for the collection of eggs for short periods during the year. The number of main stations remained the same as in 1929, but there was an increase of eight substations. The hope of increased production in the future rests largely upon the opening of new field and auxiliary stations, since the larger hatcheries are developed to the point of maximum capacity.

Stations and substations operated and output of each, fiscal year 1930

[Asterisk (*) denotes transfer of eggs. See table, p. 1136]

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total [1]
Afognak, Alaska: Sockeye salmon	4,553,200		8,620,000	13,173,200
Baird, Calif.: Chinook salmon			1,951,000	1,951,000
Battle Creek, Calif.: Chinook salmon	*1,500,000		5,187,000	6,687,000
Mill Creek, Calif.: Chinook salmon			2,883,500	2,883,500
Baker Lake, Wash.:				
Silver salmon	(*)			
Sockeye salmon	(*)		1,160,000	1,160,000
Birdsview, Wash.—				
Brook trout			5,400	5,400
Chinook salmon	* 225,000	1,427,000	1,208,000	2,860,000
Humpback salmon		3,010,000	29,900	3,039,900
Silver salmon	132,000	2,320,000	276,500	2,728,500
Sockeye salmon			64,175	64,175
Steelhead salmon	* 535,000	462,000	1,244,000	2,241,000
Duckabush, Wash.—				
Chinook salmon			290,000	290,000
Chum salmon		14,171,000		14,171,000
Humpback salmon		713,500	24,500	738,000
Silver salmon		512,000	303,700	815,700
Steelhead salmon			206,000	206,000
Lake Crescent, Wash.—				
Sockeye salmon			1,672,075	1,672,075
Quilcene, Wash.—				
Chinook salmon		50,000	241,500	291,500
Chum salmon	* 250,000	9,620,000		9,870,000
Humpback salmon		110,000		110,000
Silver salmon		1,235,000	297,000	1,532,000
Steelhead salmon	* 137,500		431,000	568,500
Sultan, Wash.—				
Chinook salmon			47,400	47,400
Humpback salmon		4,400		4,400
Silver salmon		337,700	163,800	501,500
Steelhead salmon	(*)	317,260	114,000	431,260
Berkshire trout hatchery, Mass.:				
Brook trout	(*)		318,040	318,040
Catfish			400	400
Pickerel			400	400
Rainbow trout			15,795	15,795
Boothbay Harbor, Me.:				
Cod	1,661,893,000			1,661,893,000
Haddock	124,920,000			124,920,000
Winter flounder		2,434,538,000		2,434,538,000
Bozeman, Mont.:				
Black-spotted trout	132,000		1,269,200	1,401,200
Brook trout			[2] 519,255	519,255
Golden trout			10,000	10,000
Loch Leven trout	*8,819,600		178,740	8,998,340
Rainbow trout	350,100		828,610	1,178,610
Glacier Park, Mont.—				
Black-spotted trout	231,000		872,650	1,103,650
Rainbow trout			391,700	391,700
Meadow Creek, Mont.—				
Black-spotted trout		30,000	515,500	545,500
Grayling		1,100,000		1,100,000
Loch Leven trout	*2,076,500	2,116,200	1,560,000	5,752,700
Rainbow trout	*700,200		1,183,400	1,883,600
Miles City, Mont.—				
Largemouth black bass			87,550	87,550
Crappie			142,550	142,550
Sunfish			11,575	11,575
Yellow perch			100	100
Cape Vincent, N. Y.:				
Brook trout		303,500		303,500
Cisco	(*)	27,850,000		27,850,000
Lake trout	3,000	1,208,000		1,211,000

[1] Lost in transit, 86,925.
[2] 25,000 turned over to the State of Wyoming in cooperative work of this amount.

Stations and substations operated and output of each, fiscal year 1930—Contd.

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total[1]
Cape Vincent, N. Y.—Continued.				
Loch Leven trout		33,000		33,000
Pike perch		2,000,000		2,000,000
Whitefish		580,000		580,000
Yellow perch		2,200,000		2,200,000
Barneveld, N. Y.: Rainbow trout			57,220	57,220
Swanton, Vt.—				
Common sucker	6,750,000			6,750,000
Pike perch	24,850,000	15,500,000		40,350,000
Yellow perch	53,700,000	31,880,000		85,580,000
Watertown, N. Y.—				
Brook trout			579,335	579,335
Loch Leven trout			39,600	39,600
Central station, Washington, D. C.:				
Chinook salmon		7,500		7,500
Pike perch		1,800,000		1,800,000
Fort Humphreys, Va.—				
Largemouth black bass			1,271	1,271
Shad		2,120,000		2,120,000
Sunfish			230	230
Yellow perch		80,050,000	596	80,050,596
Lakeland, Md.—				
Largemouth black bass		159,300	9,391	168,691
Crappie			9,950	9,950
Sunfish			13,160	13,160
Ogletown, Pa.: Brook trout			29,960	29,960
Clackamas, Oreg.:				
Brook trout			10,000	10,000
Chinook salmon			1,065,000	1,065,000
Rainbow trout			150,000	150,000
Steelhead salmon			158,000	158,000
Applegate Creek, Oreg.—				
Silver salmon			170,800	170,800
Steelhead salmon	*1,817,000		[3] 1,915,000	3,732,000
Big White Salmon, Wash.—				
Black-spotted trout			95,000	95,000
Brook trout			[4] 122,000	122,000
Chinook salmon	*75,000		1,500,000	1,575,000
Rainbow trout			90,000	90,000
Silver salmon		432,000		432,000
Steelhead salmon			185,000	185,000
Little White Salmon, Wash.—				
Chinook salmon	*510,000		2,500,000	3,010,000
Chum salmon			[5] 403,000	403,000
Rogue River, Oreg.—				
Chinook salmon			1,030,000	1,030,000
Silver salmon	403,000			403,000
Sockeye salmon			[6] 56,500	56,500
Steelhead salmon			135,660	135,660
Salmon, Idaho—				
Chinook salmon			3,019,000	3,019,000
Rainbow trout	(*)		713,700	713,700
Cold Springs, Ga.:				
Largemouth black bass		182,750	243,850	426,600
Catfish			3,450	3,450
Sunfish			123,835	123,835
Valdosta, Ga.—				
Largemouth black bass			1,125	1,125
Sunfish			15,000	15,000
Warmouth bass			15,000	15,000
Craig Brook, Me.:				
Atlantic salmon	*755,000		106,400	861,400
Brook trout	(*)		1,177,387	1,177,387
Landlocked salmon	*15,000		349,200	364,200
Smelt	12,000,000			12,000,000
Grand Lake Stream, Me.—				
Brook trout			125,165	125,165
Landlocked salmon	*20,000		478,630	498,630
Duluth, Minn.:				
Brook trout			184,000	184,000
Cisco		6,100,000		6,100,000
Lake trout		6,166,000	101,000	6,267,000
Pike perch		9,715,000		9,715,000
Whitefish		3,195,000		3,195,000

[3] In addition to 230,000 turned over to the State of Oregon in cooperative work.
[4] In addition to 6,500 turned over to the State of Oregon in cooperative work.
[5] In addition to 35,000 turned over to the State of Oregon in cooperative work.
[6] In addition to 46,000 turned over to the State of Oregon in cooperative work.

Stations and substations operated and output of each, fiscal year 1930—Contd.

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Edenton, N. C.:				
Largemouth black bass		198,000	63,965	261,965
Catfish			1,000	1,000
Glut herring		10,000,000		10,000,000
Shad		2,350,000		2,350,000
Sunfish			42,450	42,450
Warmouth bass			295	295
Yellow perch		2,300,000		2,300,000
Erwin, Tenn.:				
Largemouth black bass		3,950	34,760	38,710
Brook trout			215,350	215,350
Rainbow trout	29,000		344,400	373,400
Rock bass			12,930	12,930
Sunfish			7,525	7,525
Fairport, Iowa:				
Largemouth black bass		64,000	24,540	88,540
Catfish			28,800	28,800
Crappie			380	380
Smallmouth black bass			1,980	1,980
Sunfish			78,965	78,965
Gloucester, Mass.:				
Cod	393,141,000	229,769,000		622,910,000
Haddock	95,424,000	36,416,000		131,840,000
Pollock		616,713,000		616,713,000
Winter flounder		159,972,000		159,972,000
La Crosse, Wis.:				
Largemouth black bass			21,095	21,095
Brook trout			804,600	804,600
Buffalofish			21,480	21,480
Carp			168,645	168,645
Catfish			13,346,805	13,346,805
Crappie			2,607,120	2,607,120
Fresh-water drum			1,005	1,005
Loch Leven trout			159,150	159,150
Pike and pickerel			187,115	187,115
Rainbow trout			232,450	232,450
Sunfish			1,765,430	1,765,430
White bass			137,110	137,110
Yellow perch			480,555	480,555
Miscellaneous			2,387,800	2,387,800
Andalusia, Ill.—				
Largemouth black bass			2,315	2,315
Buffalofish			172,000	172,000
Carp			279,025	279,025
Catfish			3,880,000	3,880,000
Crappie			3,927,000	3,927,000
Pike and pickerel			820	820
Sunfish			454,000	454,000
Yellow perch			125	125
Miscellaneous			717,100	717,100
Bellevue, Iowa—				
Largemouth black bass			25,397	25,397
Buffalofish	14,000,000		1,002,500	15,002,500
Carp	17,500,000		1,540,000	19,040,000
Catfish			26,885,600	26,885,600
Crappie			1,146,081	1,146,081
Fresh-water drum			580	580
Pike and pickerel			37,535	37,535
Sunfish			2,142,740	2,142,740
White bass			133,180	133,180
Yellow perch			4,162	4,162
Miscellaneous			2,697,000	2,697,000
Guttenburg, Iowa—				
Buffalofish	4,462,500			4,462,500
Carp	3,875,000			3,875,000
Harpers Ferry, Iowa—				
Buffalofish	4,200,000			4,200,000
Carp	40,000,000			40,000,00
Homer, Minn.—				
Largemouth black bass			56,447	56,447
Buffalofish			75	75
Carp			17,208	17,208
Catfish			4,615,000	4,615,000
Crappie			3,493,465	3,493,465
Pike and pickerel			38,888	38,888
Rock bass			150	150
Sunfish			7,825,706	7,825,706
White bass			3,210	3,210
Yellow perch			1,931,550	1,931,550
Miscellaneous			5,693,208	5,693,208

Stations and substations operated and output of each, fiscal year 1930—Contd.

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
La Crosse, Wis.—Continued.				
Lansing, Iowa—				
Buffalofish	12,950,000			12,950,000
Carp	34,000,000			34,000,000
Lynxville, Wis.—				
Largemouth black bass			35,722	35,722
Buffalofish			34,500	34,500
Carp			454,020	454,020
Catfish			19,580,950	19,580,950
Crappie			6,429,265	6,429,265
Pike and pickerel			42,800	42,800
Sunfish			6,630,660	6,660,660
Yellow perch			55,915	55,915
Miscellaneous			7,332,000	7,332,000
Marquette, Iowa—				
Largemouth black bass			131,768	131,768
Buffalofish			116,060	116,060
Carp			1,234,700	1,234,700
Catfish			16,782,375	16,782,375
Crappie			1,292,850	1,292,850
Fresh-water drum			400	400
Pike and pickerel			137,915	137,915
Sunfish			6,958,270	6,958,270
White bass			7,750	7,750
Yellow perch			172,615	172,615
Miscellaneous			127,525	127,525
Yellowstone, Wyo.—				
Black-spotted trout	*6,455,200	25,000	6,326,000	12,806,200
Leadville, Colo.:				
Black-spotted trout			65,800	65,800
Brook trout	*100,000		3,476,500	3,576,500
Loch Leven trout			102,000	102,000
Rainbow trout			459,500	459,500
Creede, Colo.—				
Brook trout			608,360	608,360
Rainbow trout	(*)			
Louisville, Ky.:				
Largemouth black bass		135,750	8,935	144,685
Rock bass			6,640	6,640
Smallmouth black bass		404,500	7,657	412,157
Sunfish			1,280	1,280
Mammoth Spring, Ark.:				
Largemouth black bass			209,500	209,500
Rock bass			26,800	26,800
Smallmouth black bass		58,000	35,139	93,139
Sunfish			255	255
Manchester, Iowa.:				
Brook trout			374,050	374,050
Rainbow trout	*258,500		231,950	490,450
Smallmouth black bass			1,100	1,100
Nashua, N. H.:				
Brook trout			286,965	286,965
Catfish			57	57
Landlocked salmon			16,950	16,950
Rainbow trout			[7] 13,803	13,803
Smallmouth black bass		17,600		17,600
Neosho, Mo.:				
Largemouth black bass		54,200	40,335	94,535
Crappie			2,800	2,800
Rainbow trout	*868,000		[8] 101,780	969,780
Rock bass			17,876	17,876
Sunfish			4,326	4,326
Bourbon, Mo.: Rainbow trout	*1,650,000			1,650,000
Langdon, Kans.—				
Largemouth black bass			82,077	82,077
Catfish			26,295	26,295
Crappie			14,885	14,885
Rock bass			2,800	2,800
Sunfish			57,170	57,170
Northville, Mich.:				
Brook trout			849,500	849,500
Rainbow trout			221,700	221,700
Smallmouth black bass			6,200	6,200

[7] In addition to 10,413 turned over to the State of Massachusetts in cooperative work.
[8] In addition to 42,200 turned over to the State of Missouri in cooperative work.

Stations and substations operated and output of each, fiscal year 1930—Contd.

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Northville, Mich.—Continued.				
Alpena, Mich.—				
Lake trout	12,000	2,268,500	554,500	2,835,000
Pike perch		4,500,000		4,500,000
Whitefish	2,000,000	20,500,000		22,500,000
Charlevoix, Mich.—				
Lake trout	400,000	[9] 20,450,000		20,850,000
Whitefish	3,200,000	[10] 59,800,000		63,000,000
Orangeburg, S. C.:				
Largemouth black bass		127,000	196,455	323,455
Catfish			505	505
Crappie			5,225	5,225
Sunfish			39,890	39,890
Warmouth bass			4,860	4,860
Georgetown, S. C.: Shad		40,000		40,000
Jacksonboro, S. C.: Shad		423,500		423,500
Put in Bay, Ohio:				
Carp		2,600,000		2,600,000
Pike perch		108,000,000		108,000,000
Smallmouth black bass			382	382
Whitefish	1,250,000	62,740,000		63,990,000
Yellow perch		1,125,000		1,125,000
Quinault, Wash.:				
Brook trout			137,300	137,300
Chinook salmon			48,750	48,750
Silver salmon	*819,216		353,000	1,172,216
Sockeye salmon	*114,000	11,050,000	1,219,540	12,383,540
St. Johnsbury, Vt.:				
Brook trout		1,714,000	8,849	1,722,849
Steelhead salmon		16,000	14,600	30,600
Pittsford, Vt.—				
Black-spotted trout	50,000			50,000
Brook trout	80,000	180,000	14,835	274,835
Landlocked salmon			2,500	2,500
Rainbow trout	13,000		2,950	15,950
York Pond, N. H.—				
Brook trout	*400,000	335,053	142,489	877,542
Landlocked salmon			988	988
San Marcos, Tex.:				
Largemouth black bass			213,455	213,455
Crappie			5,820	5,820
Rio Grande perch			5,846	5,846
Rock bass			1,850	1,850
Sunfish			66,090	66,090
Warmouth bass			1,705	1,705
Lake Worth, Tex.—				
Largemouth black bass			7,925	7,925
Catfish			950	950
Crappie			93,870	93,870
Warmouth bass			9,900	9,900
Medina Lake, Tex.—				
Largemouth black bass			7,347	7,347
Rainbow trout			1,120	1,120
Sunfish			3,070	3,070
New Braunfels, Tex.—				
Largemouth black bass			10,361	10,361
Sunfish			75,180	75,180
Warmouth bass			2,500	2,500
Saratoga, Wyo.:				
Black-spotted trout			440,000	440,000
Brook trout			563,200	563,200
Loch Leven trout			123,000	123,000
Rainbow trout			179,000	179,000
Lost Creek, Wyo.: Rainbow trout	*657,000			657,000
Spearfish, S. Dak.:				
Brook trout			822,064	822,064
Loch Leven trout			256,300	256,300
Rainbow trout	*16,457		231,950	248,407
Crawford, Nebr.—				
Brook trout			30,900	30,900
Catfish			1,650	1,650
Loch Leven trout			47,000	47,000
Rainbow trout			16,000	16,000
Sunfish			155,550	155,550
Yellow perch			15,625	15,625
Springville, Utah:				
Brook trout	(*)		519,000	519,000
Rainbow trout	643,000		[11] 980,000	1,623,000

[9] In addition to 4,977,000 turned over to the State of Michigan in cooperative work.
[10] In addition to 3,750,000 turned over to the State of Michigan in cooperative work.
[11] In addition to 50,000 turned over to the State of Utah in cooperative work.

Stations and substations operated and output of each, fiscal year 1930—Contd.

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Tupelo, Miss.:				
Largemouth black bass		296,000	106,605	402,605
Catfish			3,450	3,450
Sunfish			398,385	398,385
Aliceville, Ala.—				
Largemouth black bass			4,000	4,000
Sunfish			36,850	36,850
Friar Point, Miss.—				
Largemouth black bass			317,544	317,544
Buffalofish			29,699	29,699
Carp			693,987	693,987
Catfish			1,165,218	1,165,218
Crappie			268,120	268,120
Fresh-water drum			372	372
Pike and pickerel			5,894	5,894
Sunfish			2,310,732	2,310,732
White bass			4,291	4,291
White Sulphur Springs, W. Va.:				
Largemouth black bass			12,700	12,700
Brook trout			[12] 1,974,617	1,974,617
Loch Leven trout			[13] [14] 464,210	464,210
Rainbow trout	515,650		[15] [16] 427,129	942,779
Rock bass			5,210	5,210
Sunfish			10,206	10,206
Woods Hole, Mass.:				
Mackerel		16,502,000		16,502,000
Winter flounder	6,962,000	735,389,000		742,351,000
Wytheville, Va.:				
Largemouth black bass			1,370	1,370
Brook trout			[17] 149,000	149,000
Rainbow trout			[18] 345,030	345,030
Rock bass			19,450	19,450
Smallmouth black bass			800	800
Sunfish			47,500	47,500
Yes Bay, Alaska:				
Humpback salmon		1,389,000		1,389,000
Sockeye salmon		330,000	2,440,000	2,770,000
Steelhead salmon			82,000	82,000

[12] In addition to 110,000 turned over to the State of Virginia in cooperative work.
[13] In addition to 670,000 turned over to the State of West Virginia in cooperative work.
[14] In addition to 96,000 turned over to the State of Virginia in cooperative work.
[15] In addition to 5,000 turned over to the State of West Virginia in cooperative work.
[16] In addition to 113,630 turned over to the State of West Virginia in cooperative work.
[17] In addition to 79,000 turned over to the State of Virginia in cooperative work.
[18] In addition to 149,000 turned over to the State of Virginia in cooperative work.

EGG COLLECTIONS

As would be expected from the fact of an increased output for the fiscal year, egg collections were materially in excess of those for 1929—the increase being close to 1,000,000,000. Collections of eggs of the cod, pollock, winter flounder, pike perch, whitefish, black-spotted trout, and other species of trout were important factors in accounting for the enlargement. Several new field stations for the collection of eggs from wild trout were opened during the year, notably in Colorado and New Mexico. Loch Leven trout egg collections from the Madison River, Mont., eclipsed previous records. Further expansion of the output from station brood stock kept the purchase of commercial trout eggs from private hatcheries at a minimum; practically the only eggs secured from this source being utilized to stock cooperative hatcheries, which represented a new and additional demand. Where the bureau is able to increase its collections, both of the trout and commercial species, beyond the hatching or rearing capacity of its own hatcheries, the surplus is assigned to State hatcheries, either for their outright disposal or for hatching and rearing for subsequent distribution by the bureau.

Comparison of egg collections, fiscal years 1930 and 1929

Species	1930	1929	Species	1930	1929
Buffalofish	35,775,000	49,396,000	Black-spotted trout	18,915,000	16,202,200
White sucker	6,750,000	1,800,000	Loch Leven trout	19,391,200	15,048,100
Carp	98,625,000	28,050,000	Lake trout	58,511,420	65,354,400
Shad	7,011,000	83,806,000	Brook trout	17,094,660	16,686,110
Glut herring	30,700,000	37,740,000	Mackerel	17,759,000	3,482,000
Whitefish	240,638,000	149,712,000	Pike perch	396,325,000	228,303,000
Cisco	75,490,000	241,901,250	Yellow perch	190,490,000	214,835,000
Chinook salmon	27,400,600	49,830,200	Striped bass		13,786,000
Chum salmon	26,562,000	23,467,000	Cod	2,425,992,000	2,244,467,000
Humpback salmon	6,918,800	4,428,800	Haddock	394,575,000	475,737,000
Silver salmon	7,433,500	9,104,300	Pollock	1,028,433,000	596,132,000
Sockeye salmon	54,160,120	51,038,120	Winter flounder	3,637,839,000	3,219,880,000
Steelhead salmon	4,975,300	9,293,300			
Landlocked salmon	592,970	1,157,880	Total	8,849,612,660	7,870,015,000
Rainbow trout	21,255,090	19,377,340			

Egg-collecting stations

Station	Period of operation	Species handled
Baker Lake, Wash.: Brinnon, Wash	Nov. 25–Dec. 24	Chum salmon.
Boothbay Harbor, Me.:		
Damiscove, Me	Apr. 1–June 1	Cod.
Ebenecook Harbor, Me	Mar. 5–Apr. 9	Winter flounder.
Fisherman Island Passage, Me	Apr. 12–May 28	Cod and haddock.
Johns Bay, Me	Mar. 5–Apr. 15	Winter flounder.
	Apr. 1–May 17	Cod.
Knubble Bay, Me	Mar. 17–Apr. 8	Do.
Linekins Bay, Me	Mar. 10–Apr. 15	Do.
Little River, Me	Mar. 10–Mar. 24	Do.
Muscungus Bay, Me	Mar. 31–June 1	Cod and haddock.
Robin Hoods Cove, Me	Mar. 6–Apr. 8	Winter flounder.
Sheepscott Bay, Me	Apr. 1–June 21	Cod and haddock.
Sheepscott River, Me	Mar. 5–Apr. 9	Winter flounder.
	Apr. 1–June 1	Cod.
Cape Vincent, N. Y.:		
Chaumont Bay, N. Y	Nov. 10–Dec. 2	Whitefish and cisco.
Fairhaven Bay, N. Y	Nov. 16–Dec. 3	Cisco.
Indian Point, Ontario	Nov. 15–Nov. 30	Do.
Ling Point, Ontario	Oct. 25–Nov. 6	Lake trout.
Pigeon Island, Ontario	Oct. 16–Nov. 5	Do.
Simcoe Island, Ontario	do	Do.
Sodus Bay, N. Y	Nov. 15–Dec. 2	Cisco.
South Bay, N. Y	Apr. 21	Pike perch.
Clackamas, Oreg.:		
Jimmy Smith Lake, Idaho	June 7–June 27	Rainbow trout.
Williams Lake, Idaho	Apr. 20–May 16	Do.
Upper Clackamas River, Oreg	Sept. 4–Sept. 20	Chinook salmon.
Duluth, Minn.:		
Bayfield, Wis	Nov. 22–Nov. 30	Cisco.
Bemidji, Minn	Apr. 16–Apr. 30	Pike perch.
Betsy River, Mich	Oct. 14–Oct. 27	Lake trout.
Big Traverse Bay, Mich	do	Do.
Copper Harbor, Mich	Sept. 25–Oct. 9	Do.
Gay, Mich	Oct. 14–Oct. 27	Do.
Grand Marais, Mich	Oct. 17–Nov. 5	Do.
Huron Island, Mich	Oct. 14–Oct. 26	Do.
Isle Royale (Mich.) ports	Sept. 25–Nov. 17	Lake trout and whitefish.
Keystone, Mich	Oct. 14–Oct. 25	Lake trout.
Manitou Island, Mich	Oct. 13–Oct. 19	Do.
Marquette, Mich	Oct. 14–Oct. 29	Do.
Munising, Mich	Oct. 15–Oct. 27	Do.
Portage Entry, Mich	Oct. 14–Oct. 27	Do.
Portage Lake Ship Canal, Mich	Oct. 10–Oct. 27	Do.
Gloucester, Mass.:		
Boars Head, N. H	Feb. 1–May 20	Cod.
Marblehead, Mass	Feb. 20–Mar. 15	Do.
Plymouth, Mass	Nov. 1–Mar. 10	Cod and pollock.
Rockport, Mass	Nov. 1–May 20	Pollock, cod, haddock.
Leadville, Colo.:		
Continental Reservoir, Colo	May 12–June 22	Black-spotted trout.
Eagle Nest Lake, N. Mex	Apr. 15–June 12	Rainbow trout.
Mount Massive Club Lakes, Colo	Oct. 16–Dec. 11	Brook trout.
Trinchera Reservoir, Colo	May 1–June 13	Rainbow trout.
Turquoise Lake, Colo	Oct. 19–Dec. 7	Brook trout.
Wurts Lakes, Colo	Oct. 18–Nov. 22	Do.
Nashua, N. H.: Lebanon, N. H	Apr. 3–Apr. 14	Rainbow trout

Egg-collecting stations—Continued

Station	Period of operation	Species handled
Northville, Mich.:		
Alcona, Mich	Nov. 1–Nov. 3	Lake trout.
Beaver Island, Mich	Oct 17–Nov. 24	Do.
Black River, Mich	Nov. 3–Nov. 6	Do.
Cheboygan, Mich	Oct. 26–Nov. 23	Lake trout and whitefish.
Detour, Mich	Oct. 29–Nov. 6	Lake trout.
Epoufette, Mich	Nov. 8–Nov. 20	Whitefish.
Fairport, Mich	Nov. 12–Nov. 17	Do.
Leland, Mich	Nov. 12–Nov. 24	Lake trout.
Manistique, Mich	Nov. 12–Nov. 17	Whitefish.
Middle Island, Mich	Oct. 30–Nov. 2	Lake trout.
Northport, Mich	Nov. 12–Nov. 24	Do.
Oscoda, Mich	Nov. 6–Nov. 15	Do.
Rockport, Mich	Oct. 26–Nov. 26	Lake trout and whitefish .
St. Ignace, Mich	Oct. 26–Nov. 24	Do.
Put in Bay, Ohio:		
Catawba Island, Ohio	Nov. 6–Nov. 30	Whitefish.
Middle Bass, Ohio	Nov. 6–Nov. 28	Do.
	Apr. 8–May 1	Pike perch.
North Bass, Ohio	Nov. 6–Nov. 28	Whitefish.
	Apr. 8–May 1	Pike perch.
Port Clinton, Ohio	Nov. 6–Nov. 30	Whitefish.
	Apr. 7–May 5	Pike perch, yellow perch.
	June 2–June 23	Carp.
Toledo, Ohio	Nov. 7–Nov. 30	Whitefish.
	Apr. 7–May 5	Pike perch.
Saratoga, Wyo.:		
Big Creek Lakes, Colo	Sept. 9–Nov. 2	Brook trout.
Lost Creek, Wyo	Mar. 24–June 21	Rainbow trout.
Springville, Utah:		
Fish Lake, Utah	Oct. 28–Dec. 10	Brook trout.
	Apr. 22–May 16	Rainbow trout.
Pyramid Lake, Nev	Apr. 4–Apr. 17	Black-spotted trout.
Woods Hole, Mass.:		
Groton, Conn	Mar. to Apr. 5	Cod, haddock, winter flounder.
Waquoit, Mass	Jan. to Apr	Winter flounder

FISH-CULTURAL NOTES

NEW STATIONS

Among the new plants to which reference was made in the previous year's report the substations at Crawford, Nebr., and Fort Worth, Tex., are now operating close to full production with present facilities. At the former point a good distribution of trout was achieved and work was started on the construction of a dam to create a large lake on the Fort Robinson Military Reservation for the propagation of warm-water fish. A number of small local ponds were utilized for producing a limited number of bream, catfish, etc. The ultimate capacity for rearing trout at Crawford will not be attained until a pipe line, connecting a spring-water supply, is run to the present hatchery. This work was in progress at the close of the fiscal year. Development has continued at the Valdosta (Ga.) station; and a limited distribution of bass and bream, principally the latter, was obtained for the benefit of local waters. In view of the extensive pond acreage at this point, the securing of an adequate brood stock has been slow and difficult. Additional drainage wells will be drilled to facilitate the drainage of Grassy Lake, the main hatching and rearing pond.

At the Tishomingo (Okla.) substation, buildings were constructed; and a temporary dam, designed to give an immediate water supply for a small number of ponds, was installed. High water during the spring destroyed this structure, and no fish-cultural work could be carried on during the summer of 1930. At the close of the fiscal year, work had just been started on a permanent dam and ditch which will insure an adequate water supply for ponds to be constructed later. A hatchery building and a combination workshop and garage were completed at the Creede (Colo.) substation, and work was started on a dwelling. This new project hatched a considerable number of trout eggs during the winter and was the base for new field egg-collecting operations in southern Colorado and northern New Mexico. Minor expansion of facilities occurred during the year as is shown in the individual reports.

FIVE-YEAR EXPANSION PROGRAM

Final enactment by Congress, during May, of the 5-year expansion program for the bureau provided for over 30 new or expanded fish-cultural activities. The new hatcheries authorized under the terms of this legislation are located throughout the country in sections which are not easily cared for by the bureau's existing hatcheries. While no new work under the authorization of this bill was undertaken during the fiscal year 1930, the matter is mentioned as an indication of the viewpoint of Congress relative to the desirability of expanding Federal fish-cultural operations. At the end of the 5-year period covered by the program the stations and activities of the division of fish culture will have been virtually doubled in number and magnitude. The major part of the development is to be devoted to the interests of game-fish propagation.

FISH FOOD

The report for 1929 mentioned an experiment with a prepared trout food made from dried salmon eggs as being under way at the Bozeman (Mont.) station. On the basis of favorable results the experimental trout station at Pittsford, Vt., utilized some of this material, and preliminary findings indicate that it has high value, both in producing growth and in giving the high coloration characteristic of wild fish.

REFRIGERATING PLANT FOR FISH FOOD

During the year there was installed at the Little White Salmon (Wash.) substation a complete cold storage and refrigerating plant for the purpose of freezing and holding spawned-out salmon carcasses to be utilized as fish food at the Columbia River stations. It is believed that frozen salmon carcasses are more suitable for feeding young salmon than those which have been preserved by salting or other methods. In view of the low cost of the raw materials, it is believed that its preservation by refrigeration will provide a cheap and satisfactory food, and that the refrigerating plant will ultimately represent a real economy.

BLACK-SPOTTED TROUT EGG COLLECTIONS, PYRAMID LAKE, NEV.

In cooperation with the State of Nevada, Pyramid Lake, which is located on lands belonging to the Carson Indian School, was taken over during the spring of 1930 by the bureau as a field collecting station for black-spotted trout eggs. This was formerly a productive source of early black-spotted trout eggs, but difficulties arising with the Indians who control operations at this point prevented the State of Nevada from continuing. By the time the necessary permission was received from the Indians for the bureau to proceed, the season had virtually passed and collections were negligible. The work will be followed up, however, and the total output replanted in the lake for a number of years with the object of restoring it to its former productivity.

DISTRIBUTION BY TRUCK

A number of the eastern stations are distributing increasing proportions of their output by motor truck. Unlike the practices followed in the West, where transportation trucks are equipped with air compressors or oxygen tanks, the bureau is utilizing an ordinary aluminum distribution pail and is depending upon the motion arising from the travel to provide aeration. It has been found quite practicable to distribute trout and bass in this manner within a radius of practically 100 miles from the station. While the charging of the initial cost of the truck and all cost of maintenance and upkeep to distribution might result in an expense equivalent to, or slightly above, the cost by rail, the fact remains that these stations maintain a truck for other purposes. Hence no additional overhead or other expense is involved in utilizing them for distribution purposes. It is probable that, as the number of stations is increased and the distribution hauls shortened, there will be a considerable increase in this method of transporting fish.

EFFECT OF WEATHER CONDITIONS ON FISH CULTURE

The past year presented a particularly striking example of the hindrance which may be exerted on fish-cultural operations by unfavorable weather. During the fall the lake trout egg collections at the Duluth (Minn.) station were reduced to a small fraction of normal on account of gales on Lake Superior preventing fishing operations. Floods during May at the San Marcos (Tex.) station overran the grounds and curtailed what had promised to be a very satisfactory distribution of pondfish. Unseasonable and cold weather during the spring reduced the production of pondfish at the South Carolina and Georgia stations. Operations with the shad at Fort Humphreys, Va., and the striped bass at Weldon, N. C., were a virtual failure owing to abnormal water conditions arising from prolonged dry weather preceding the spawning season. By the close of the fiscal year the continuation of this drought had seriously affected the water supply at a number of the eastern trout stations; and unless normal conditions return shortly, the water shortage may be reflected in subsequent egg collections at these points. Dry weather conditions on the Pacific coast have affected the flow in some of the salmon streams, preventing or discouraging the entrance of the fish and causing a shortage in the collection of eggs.

COMMERCIAL SPECIES

The propagation of commercial species of fish is a contribution to the public good, the exact results and value of which can not be accurately estimated. The intensive stocking of specific locations for a period of years with commercial forms, such as the flounder, whitefish, lake trout, or the Pacific salmon, has clearly demonstrated, by the increased catches of fish, that worthwhile results are obtainable. The general work of this nature, however, is more widespread and divergent, and the results of the hatchery operations are obscured by normal fluctuations in catch; traceable, in part, to other factors such as weather conditions.

The artificial propagation of commercial forms may be considered as supplementary to the natural reproduction arising from the vast natural stock which must be existent to support a commercial fishery. The comparatively limited cost per unit of production, however, makes it highly desirable to assist nature by hatchery operations. As has been previously pointed out, the increased aggregate production for the past year is due largely to the augmented distribution of eggs and fry of the commercial species. One of the most noteworthy features in connection with this work during 1930 was the virtual failure of all shad operations, due to water conditions arising from drought.

PACIFIC SALMONS

On the Pacific coast field, operation of the salmon hatcheries was marked by a practically normal output at the Alaska stations, a moderate increase in the California field, and sharp declines in the output of the Puget Sound and Columbia River establishments. The latter condition was due to prolonged dry weather which brought the rivers to an extremely low level and deranged the normal spawning migrations. The decline was particularly noticeable in the case of chinook and sockeye salmon; while the only forms that registered an increase were the humpback and steelhead trout.

AFOGNAK (ALASKA) STATION

[A. T. LOOFF and HARRY F. JOHNSTON, Superintendents]

The escapement of sockeye salmon into Letnik Lake during the season of 1929 amounted to 25,428. Of these, 8,360 female fish were spawned. They yielded 22,000,120 eggs of good quality, of which 4,553,200 were forwarded, when eyed, to the bureau's headquarters at Seattle, Wash. All the young salmon hatched were retained and fed, well into the month of June, before being liberated in the lake and its tributaries. Early in May steelhead-salmon eggs to the number of 123,904 were collected at the outlet of Letnik Lake and by the close of the fiscal year had attained the eyed stage. The migration of sockeyes occurred during a high-water period in May; and while schools of considerable extent were observed in tributaries of the lake, it was impossible, owing to the roily condition of the water, to form any estimate of the number migrating.

Saw logs, cut during the winter in the woods and transferred to the station sawmill, were made into lumber. Forty thousand board feet of suitable sizes for future construction and repair work were manufactured from 170 logs, with 50 logs remaining to be cut. In the course of the year a new woodshed was constructed, a bridge was built across Hatchery Creek on the station grounds, and several other improvements of a minor character were made. The construction of a highway 4½ miles in length, between the station and the boat landing at Letnik Bay was started June 14 and the work was completed on November 30, 1929. The building of this road was financed and supervised by the Bureau of Public Roads. Its completion has made possible the use of a truck, thus expediting the station's activities to a considerable extent.

YES BAY (ALASKA) STATION

[A. T. LOOFF, Superintendent]

Fish-cultural work at this station during the fiscal year 1930 was concerned chiefly with the sockeye salmon, though limited numbers of humpback salmon were also handled. While the egg collections of the first-named species were somewhat below the average, an abundant supply of excellent food material, made available through the cooperation of the New England Fish Co. of Ketchikan, Alaska, permitted the feeding of the fingerlings for a much longer period than has been possible heretofore in this field. The protection afforded the fish from their natural enemies by their increased growth and development before liberation should be productive of satisfactory results. Two million four hundred and forty thousand young sockeye salmon carried over from last year's stock, were held in ponds and fed until July 27 and then released as fingerlings No. 2 in Lake McDonald. The season's spawn-taking operations yielded 16,095,000 eggs of the sockeye salmon and 2,650,000 of the humpback salmon. Of the fry hatched from the former, 330,000 were planted in the hatchery slough as advanced fry, 6,002,000 were released in Lake McDonald in the No. 1 fingerling stage, and 8,000,000 fingerlings No. 2 were being fed in the station ponds when the year closed. On reaching the eyed stage 1,021,000 of the humpback eggs were distributed. The remainder were incubated, producing 1,389,000 fish which were planted in the hatchery slough in the advanced fry stage.

Owing to the extremely wet climate in this region, walks, building foundations, tramways, and in fact all equipment of wood construction are subject to rapid decay. Frequent repairs and replacements are essential to maintain them in first-class condition. Many items of repair of a miscellaneous nature were attended to in the course of the year, one of the most important being the rebuilding of 2,200 feet of pipe-line trestle. The capacity of the station's feeding pond system was increased considerably by the extension of feeding walks to the upper portion of the hatchery slough.

BIRDSVIEW (WASH.) STATION AND SUBSTATIONS

[JOSEPH KEMMERICH, Superintendent]

Operations in Baker Lake field were conducted throughout the entire year at the five permanently established stations. In addition the Walcotts Slough trap at Brinnon, Wash., was operated from November 25 to December 24; and from February 11 to June 27, sockeye salmon rearing operations were in progress at the Lake Crescent State hatchery. Eggs of the five species of Pacific salmon and steelhead were handled. The run of chum salmon in Duckabush River and in Walcotts Slough was the largest in recent years, and a capacity collection of these eggs was made at the Hoods Canal substations. The humpback-salmon egg collection at Birdsview exceeded that of any year since 1907. Egg collections of the other four species handled were below normal, however, and unfavorable weather conditions were partly attributable therefor. The total egg collection at all points amounted to 37,417,500, exceeding by 7,097,700 the take of the previous year, but falling short of the collection in 1928 by 6,320,000. In addition to the eggs collected 7,392,152 were received by transfer from other fields and handled in connection with those taken locally. Eyed eggs to the number of 2,620,500 of the different species were shipped to points in various States, to Hawaii, and to South America. The Birdsview and Quilcene stations cooperated with the Skagit and Jefferson County game commissions, respectively, in hatching and rearing trout.

Fluke-infested liver was fed in all fields with apparently satisfactory results, and at a considerable saving in cost as compared with former years. Experiments were conducted with various foods with the view of ascertaining which would give the best satisfaction in combination with salted salmon. Continued investigation of streams in the Puget Sound watershed was made during the year and considerable information gained concerning the spawning grounds of the chinook and humpback salmons. Notwithstanding the fact that all streams were at an unusually low stage throughout the entire fall there was a good run of the chinook and humpback salmon. Streams, lakes, and springs in the Mount Rainier National Park were inspected in a search for a suitable trout rearing site. Though alterations were made in the device for the hoisting of the 1929 run of fish over the power dam in Baker River at Concrete, Wash., there was no improvement in the results. Of the 1,379 sockeye salmon put over the dam only 960 ascended to Baker Lake, and the total egg collection amounted to 765,000. The comparative insignificance of this work is brought out by the fact that during the fiscal year 1924, which immediately preceded the installation of the Baker River Dam, 14,558 sockeyes were caught in Baker Lake and 22,000,000 eggs secured from them.

Birdsview (Wash.) station.—The exteriors of all station buildings were painted two coats and the interiors of several of the cottages were repainted. Minor repairs and alterations were made to the fish-culturist's cottage and several other buildings. Late in August a temporary wood trap was constructed in Phinney Creek with the object of collecting humpback and chinook salmon eggs. Throughout the spawning period of the chinook, humpback, and sockeye salmons the water level in Grandy Creek remained too low for the ascent of fish, but a slight rise occurring after December 10 permitted the entrance of a small run of silver salmon from which eggs to the number of 1,218,000—about half the take of a normal season—were secured. The run of steelhead salmon was also small, and the take of eggs amounted to not more than one-third the average collection. From Phinney Creek 3,325,000 humpback salmon eggs and 180,000 chinook eggs were obtained between September 7 and October 14, the former figure representing the largest season's collection ever made in that stream. In addition to the local egg collections, shipments from other fields received and handled comprised 214,816, sockeye; 2,842,000, chinook; 1,671,320, silver; 1,021,000, humpback; 250,000, chum; and 209,000, steelhead salmon eggs. Consignments of eyed eggs forwarded from Birdsview to destinations in the various States, Hawaii, and South America included 285,000 chum salmon; 1,021,000 humpback salmon; 250,000 chum salmon; 114,000 sockeye salmon; 225,000 silver salmon; and 588,000 steelhead-salmon eggs. Feeding operations were conducted to the full capacity of the station in July and August, and again in the spring from April 1 to the close of the year. In an effort to determine whether age or size is the factor governing the return of the fish, 48,000 yearling sockeye salmon were marked and liberated in Skagit River.

Baker Lake (Wash.) substation.—Only such minor repairs and improvements were made as were essential to the maintenance and proper operations of the station. The 522,500 sockeye fingerlings on hand at the beginning of the fiscal year were all liberated by July 27. Of the 765,000 sockeye eggs secured, 100,000 were transferred to the Birdsview station. The fingerlings resulting from the remainder were liberated in Baker Lake prior to the close of the year. Silver salmon to the number of 5,876 were put over the dam. Of these, 1,428 ascended to the station where 1,529,000 eggs were taken from them and transferred to Birdsview. A considerable run of landlocked sockeye salmon again entered Baker Lake, but only a few were caught as the trap webbing meshes were too large to intercept them.

Duckabush (Wash.) substation.—During August the temporary trap was installed in the Duckabush River for collecting eggs of the early run chum and humpback salmons, and on October 1, when all eggs that could be cared for at the Duckabush and Quilcene stations had been secured, it was removed. All station buildings were painted, 40 new troughs and a new head trough installed in the hatchery, and the permanent trap, which had been damaged by flood waters on November 12, 1928, was repaired and lengthened 48 feet in order to allow flood waters a greater escapement area. In the Duckabush River the early run of chum salmon was the largest in years, while the run of humpback salmon appeared to be fully as large as two years ago. At the temporary trap in the river, 10,165,000 eggs of the early chum salmon and 812,000 of the humpback salmon were collected between September 5 and 28. On account of shortage in the hatchery water, 4,256,000 of the chum eggs had to be cared for at the Quilcene station until late November, when the water supply increased sufficiently to permit of their return to Duckabush for the completion of incubation. There were also collected for the Quilcene station 3,606,000 early chum eggs and 127,000 of the humpback salmon. The maximum numbers of eggs of both species that could be handled in these fields having been collected by October 1, steps were taken on that date to remove the temporary trap and allow the remainder of the run to ascend the river. At the Walcotts slough trap, 5,010,000 eggs of the late run of chum salmon were obtained between December 15 and 24.

The runs of silver and steelhead salmon in the Duckabush River, apparently, were below normal, and the egg collections of both species were small. A lot of 753,600 eyed silver-salmon eggs was received from the Quinault station and handled in connection with the local collections. The effort undertaken in 1925 to establish a run of chinook salmon in the Duckabush River was continued, the product of 300,000 eggs of that species transferred during November from the Little White Salmon station being utilized for the purpose. The feeding of chinook, silver, and steelhead salmon fingerlings was prosecuted to the station's capacity. The only stock remaining on hand when the year closed was a lot of 46,600 steelhead fingerlings.

Quilcene (Wash.) substation.—All station buildings were painted, and the interiors of the two cottages repainted and varnished. With the view of increasing the hatching capacity of the station, which of late years has been too small to accommodate all eggs available, an outside battery of 36 troughs was constructed at the rear of the hatchery building. At the beginning of the fiscal year there were on hand 135,000 fry and 300,000 fingerling steelhead salmon. These fish were distributed before the close of July. The run of chum and silver salmon was below normal but the steelhead salmon egg collection was larger than in recent years. The short run of the two first named species is attributed to the low water level in the Big Quilcene River during the early part of the season. A total of 1,630,000 early-run chum salmon eggs was obtained from the Big Quilcene and Little Quilcene River traps between September 5 and October 1. This collection was augmented by 3,606,000 eggs of the same species obtained at the Duckabush River temporary trap between September 28 and October 1, and 4,256,000 of these eggs were eyed for the Duckabush station, owing to an inadequate water supply at that hatchery. Silver salmon eggs were collected from November 25 to February 19 to the amount of 948,000, and 716,064 of that species were received from the Quinault field.

Steelhead-salmon eggs to a total of 578,000 were collected between February 26 and May 10. Chum salmon to the number of 250,000 and 69,000 steelhead-salmon eggs were transferred to the Birdsview station. In continuation of the effort undertaken several years ago to establish a run of chinook salmon in the Big Quilcene River and Lyre River and to increase the run in the Docewallips River, 300,000 eggs of that species were transferred from the Little White Salmon station, hatched, and the resulting fry and fingerlings liberated in these streams. One hundred thousand eastern brook trout eggs were received from Colorado. During the spring months feeding operations to the capacity of the station were conducted.

Walcotts Slough (Wash.) substation.—Collections of late chum salmon eggs were made jointly at this point for stocking the Duckabush and Quilcene hatcheries. From November 25 to December 17 employees of the former secured 5,027,000, and an approximately equal number was obtained by the Duckabush personnel between the 15th and 24th of that month. On the latter date the trap was opened and the remainder of the run given access to the entire slough for natural spawning. At least 5,000,000 additional eggs might have been collected had space for developing them been available at the Hoods Canal stations. All fry resulting from the collections made at this point for the Duckabush and Quilcene stations were returned at the expiration of the sac stage to their native waters.

Sultan (Wash.) substation.—Early in September a temporary rack was installed in Elwell Creek with the intention of trapping the run of chinook and humpback salmon. The efforts were rendered almost futile, however, by the extremely low-water level prevailing and a sudden flood occurring on October 17. The young fish developed from the 37,000 eggs and 404,000 fry of the steelhead salmon on hand at the opening of the year were all distributed before the end of July. In the face of the unfavorable water conditions the collection of eggs was far below normal, the total of the four species handled amounting to only 837,500. Part of the steelhead eggs secured were transferred to the Birdsview station. All of the chinook, humpback, and silver salmon produced were liberated before the close of the fiscal year, and only a small stock of steelhead fry and fingerling fish were on hand at that time.

Lake Crescent (Wash.) State trout hatchery.—In continuation of the attempt begun in 1927 to establish a run of sockeye salmon in Lake Crescent through the Lyre River from Puget Sound, eyed eggs of that species to the number of 1,028,350 were transferred to the station from the Quinault field, with the view of rearing the resulting fry to the fingerling stage before liberating them. The young fish were fed from April 26 to June 27 when the resulting fingerlings, amounting to 953,500, were planted in the lake. Returns in the Lyre River are expected this summer from the first fish liberated in Lake Crescent in June, 1927, and accordingly a close watch is being maintained.

QUINAULT (WASH.) STATION

[Marcus S. Meyer, Superintendent]

The fish-cultural work of this station is directed principally to the propagation of sockeye salmon. During the fall spawning season from November 3 to December 30, 15,300,000 eggs of this species were collected, together with 3,000,000 of the silver salmon and a small number of chinook-salmon eggs. Practically throughout the spawning season the water in the streams of the region was at an extremely low stage. This caused many of the fish to spawn

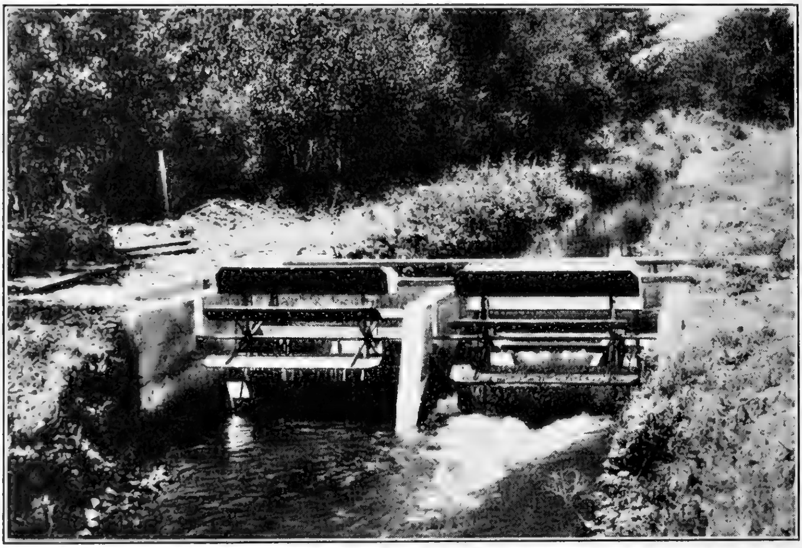

Figure 1.—Upstream view of mechanical fish screen in irrigation canal near Yakima, Wash. Installed to overcome loss of young salmon in ditches

along the shores of the lake and rendered the movement of fish canoes and equipment a somewhat laborious task. In order to provide sufficient room for the development of the sockeye-salmon fry it was found necessary to transfer the silver-salmon eggs in the eyed stage to other stations for the completion of incubation. The stacked-tray system for handling the fry was used with excellent results. A large pool just below the falls in Falls Creek was screened off and used for the rearing of 500,000 of the fingerling salmon after filling the hatchery and station ponds to capacity.

Extensive repairs were made to the hatchery building early in the fiscal year. The foundation being bady rotted, it became necessary to renew foundation posts, sills, floor joists, and flooring. While such work was going on, the hatching troughs were removed to the station workshop; and, after completing repairs to the building, new trough horses were constructed and the troughs were again set up and painted. A 65-foot section of the flume supplying water for grinding fish food was rebuilt; and a temporary flume, 200 feet in length, was constructed from the hatchery head trough to connect with the flume just above the hatchery settling tank. The purpose of this flume is to supply water to the hatchery while a new concrete settling tank was in course of construction.

CLACKAMAS (OREG.) STATION AND SUBSTATIONS

[PHILO B. HAWLEY, Superintendent]

Operations in the Oregon field were conducted at six permanent stations, and efforts were directed toward the maintenance of the run of salmon in the States of Oregon, Idaho, and Washington. The fish-cultural work at these stations was concerned chiefly with the propagation of the chinook and steelhead salmons, though small numbers of the silver, chum, and sockeye salmons were also handled, as well as several species of trout. The total egg collections amounted to only 22,500,000, as compared with approximately 52,000,000 in the preceding year. The very decided falling off in results is attributed to the extremly low-water stages which prevailed in nearly all streams throughout the field. As in previous reports acknowledgement is made of the very hearty cooperation afforded by the Oregon State Fish and Game Commission, both financially and otherwise.

Clackamas (Oreg.) station.—Owing to repeated failure of egg collecting operations in the Clackamas River during the seasons of 1928 and 1929, no racks were installed; and it transpired that such action was justifiable, since only a very few chinook salmon ascended the stream. To offset this failure to secure spawn 1,230,000 eggs of this species were transferred from other points and the resulting fish were reared to the No. 2 fingerling stage before liberation. All eggs collected at the upper Clackamas substation were also hatched here; and the fish produced therefrom were returned, in the No. 2 fingerling stage, for planting in the waters from which they were derived. Shipments of steelhead, rainbow, and brook trout eggs were also handled. Facilities at this station have recently been improved by the installation of a cold-storage room for the preservation of fish food. This room has a capacity for holding 2 tons of meat. In cooperation with Oregon Game Commission fishery exhibits were displayed at the State fair at Salem, Oreg., and at the Pacific Coast International Stock Show at Portland. Both exhibits occasioned favorable comment.

Little White Salmon (Wash.) substation.—The construction of the cold-storage plant at this station, undertaken prior to the beginning of the year, was completed. This plant which provides for the freezing of 2 tons of fish in 24 hours and has a holding capacity of 70 tons, will be used for the storage of food for both the Little White Salmon and Big White Salmon stations. A number of skiffs were constructed for use in this and in other fields. Chinook-salmon egg collections were the poorest in years, only 9,830,000 being secured as compared with 20,172,000 in 1928, and 26,600,000 in 1927. Increased commercial fishing is given as one reason for this. About 500,000 chum-salmon eggs were also collected and nearly 2,000,000 chinook eggs were transferred here from other collecting points. A normal percentage of hatch was secured and the resulting fry were held by the stacked-tray system. The young fish were fed on horse meat and spawned-out salmon preserved by freezing, about 8 tons of the latter being used for food in the course of the season.

Big White Salmon (Wash.) substation.—The usual preparations were made for the collection of chinook-salmon eggs in the Big White Salmon River and Spring Creek. The latter was formerly barren of salmon, but through the efforts of the station in making frequent and heavy plants of young fish, a run of salmon was established and has been built up to very fair proportions. The season's collection of eggs proved disappointing, only 5,845,000 being obtained. By means of the station truck, the eggs collected in the Big White Salmon River were successfully transported from the racks to the hatchery in the green state. Five hundred and fifty thousand of the eggs were transferred to the main station at Clackamas. From the eggs retained a normal percentage of hatch was secured and nearly 5,000,000 fish were reared to No. 2 and No. 2½ fingerlings for liberation in the Columbia River. Spawned-out salmon to the amount of 4 tons, preserved at the Little White Salmon station by freezing, was fed to the young fish in connection with 7,000 pounds of horse meat and liver. In addition to the propagation of chinook salmon nearly a million brook, rainbow, and steelhead eggs were incubated and the product reared. Most of these were cared for as a courtesy to the Klickitat Game Commission, and the resulting fingerlings were liberated by the commission in mountain lakes and streams in this county. Increased illegal net and troll fishing off the mouths of the Little White Salmon and Big White Salmon Rivers at the time adult salmon were preparing to ascend these streams necessitated the employ of patrolmen during this period. The bureau employed one man, and another was employed by the Oregon Game Commission.

Rogue River (Oreg.) substation.—Rearing facilities at this point were improved by the installation of a 4-inch centrifugal pump operated by a 10-horsepower electric motor. The chinook spawning season, which opened September 9, was an extremely disappointing one; only 588,000 eggs were secured, representing the smallest take in years. The failure is ascribed in part to the spacing of the head-rack pickets 2½ inches apart instead of 2 inches. This action was taken owing to complaints received from various sportsmen to the effect that the 2-inch spacing prevented steelhead and other trout from ascending the river. No other collections were made but a consignment of sockeye salmon eggs was received. The fry from these were transferred to the Butte Falls hatchery of the Oregon Game Commission for rearing. In cooperation with that commission, a census of the chinook salmon ascending Rogue River to spawn was taken at the Savage Rapids Dam. Up to July 1 approximately 24,000 salmon had ascended.

Applegate Creek (Oreg.) substation.—Approximately 1,700,000 steelhead trout were on hand July 1, 1929, and in the course of that month 1,685,000 of them were liberated in Applegate Creek. The run of silver salmon in this stream was almost a failure, only 190,000 eggs being taken. Very favorable results attended the efforts to collect steelhead eggs and slightly more than 3,000,000 were secured. As a result of severe criticism from sportsmen and others of the region, spawn was this year collected from steelhead trout without killing the fish and all spawned-out fish were returned to the waters of Applegate Creek. After making the desired shipments of eyed steelhead eggs the remaining eggs and fry were transferred to the Butte Falls hatchery of the Oregon Game Commission for rearing. By this means the fish were reared to a larger size than would otherwise have been possible, and the expense of operating the Applegate Creek hatchery during June was eliminated.

Salmon (Idaho) substation.—At the opening of the year 786,000 rainbow-trout eggs were on hand. A consignment of 50,000 of these was transferred to the bureau's Leadville (Colo.) station, and nearly 714,000 fingerling fish, the product of the remainder, were planted in the mountain streams of the region. The run of spring chinook salmon in the Lemhi River was almost a failure, only 351,000 eggs being collected. After carrying them to the eyed stage at the point of collection, these were transferred to the main hatchery at Salmon for the completion of incubation. With the view of assisting to maintain the run of spring chinook salmon in the Salmon River, 2,720,000 eggs were transferred here from the McKenzie hatchery of the Oregon Fish Commission. Of the total of 3,071,000 chinook eggs handled, 3,055,000 were hatched and approximately 3,000,000 No. 1 fingerlings were produced and liberated in the Lemhi River or its tributaries. The State of Idaho cooperated with the bureau in collecting 1,468,000 rainbow-trout eggs in Williams and Jimmy Smith Lakes. With the exception of a normal loss this collection, in the form of eggs and fry, was on hand at the end of June, 1930.

BAIRD (CALIF.) STATION AND SUBSTATIONS

[W. K. Hancock, Superintendent]

General repairs and improvements were made to the station buildings in the summer of 1929. Two new plank and earth ponds were built back of the power house and fed through a flume from a settling tank. Another pond was constructed in front of the mess house and fed from a spring. Seining for chinook salmon in the McCloud River was undertaken on September 3 and continued at intervals until October 14, during which time 500,000 eggs were taken. While this may be considered a small collection, it was much larger than any that had been made in the river in the recent past. Experience having demonstrated that there would be no opportunity to add to it by attempted collections from the limited run of fall fish, the racks were removed from the river at the close of the early run. All spent salmon used in the work were salted down for fish food.

There being no water in the gravity ditch, the eggs were developed in troughs set up outside the hatchery. The stock was held in this way until the growing fish became crowded, when they were transferred to the hatchery.

One million five hundred thousand eyed chinook eggs, received from the Battle Creek auxiliary, were hatched; and from the combined stock, plants of 1,951,000 fingerling fish were made in the McCloud River at Baird and in the Sacramento River near Redding, Calif. Heavy rains in December washed away the flumes at the head of the gravity ditch and necessitated the pumping of water from the river for a period of several weeks while the equipment was undergoing repair. Snow to a depth of 3 feet fell during the winter, this amount exceeding that of any season's snowfall within the past 12 years. The station roads, which were badly damaged by heavy precipitation during the winter, were repaired in the spring with earth and gravel hauled for the purpose. In April, the racks were again installed for the interception of the spring run of salmon. During the early summer, forest fires threatened the destruction of the power lines. They were finally gotten under control by the efforts of a large force of men, and no damage was done to station property. In the course of the year the station superintendent visited the two substations as often as was deemed necessary to exercise general supervision over the work and give needed instructions to the officials in charge.

Battle Creek (Calif.) substation.—During the summer needed repairs and improvements were made on the station buildings. A new pond was constructed across the gulch west of the hatchery. In September racks were installed in Battle Creek, and fishing began on October 1. The run of fish was larger than in some years, and eggs to the number of 7,674,800 were collected. Contrary to recent practice, no seines were operated in the Sacramento River, the full attention of the station force being required in making local collections. On account of the occurrence of heavy storms when the eggs were in the tender stage, many were lost and large numbers of weak fry developed which soon succumbed. Slightly more than two-thirds of the 5,301,000 fry hatched were reared to the fingerling stage, and all fish produced were planted in Battle Creek.

Mill Creek (Calif.) substation.—Prior to the opening of the fishing season the old supply flume from the main ditch to the hatchery, a distance of 225 feet, was rebuilt with a half-circle galvanized-iron flume 2 feet in width and about 12 inches deep, equipped with a concrete head gate. The racks were installed in August and fishing extended from November 6 to December 7, resulting in the collection of 1,800,000 eggs. After the run of fish was over the racks were removed and all equipment was stored, just in time to prevent its washing away by high water. The smaller than normal collection made was due to the refusal of the local irrigation company to turn water into Mill Creek until November 1, by which time most of the fish that would otherwise have entered the creek had passed on up the river. All available water is used during the summer for irrigation and throughout that period the creek is practically dry. The company has promised that during the coming year water will be turned into the creek by the middle of October. From the eggs collected and 600,000 eyed eggs transferred from the Battle Creek substation, 2,385,000 fry were hatched. These were reared until the end of March and then liberated, as the water was taken at that time by the irrigation company. During the short feeding period 1,100 pounds of salmon and 200 pounds of beef melts were consumed.

FISHES OF THE GREAT LAKES

In contrast to conditions during the past two or three years, the aggregate output of whitefish, lake trout, and pike perch was markedly increased. The only variety which failed to reach the numbers of the previous year was the cisco or lake herring. The increase was largely credited to the highly successful operations of the Michigan stations, although the pike-perch output was augmented by a good production at the Put in Bay (Ohio) station. The Cape Vincent (N. Y.) station was materially curtailed in its whitefish and lake-trout operations, as was true with the latter species at the Duluth (Minn.) station. Had weather conditions permitted an average output at these two establishments, the total distribution for the entire territory would have been close to previous high records.

DULUTH (MINN.) STATION

[WARD A. COOK, Superintendent]

Collecting stations in the Lake Superior field were opened shortly after the middle of September for the reception of eggs from an unusually early run of lake trout and approximately 500,000 were taken before the beginning of the closed season in Michigan waters. From that time on collections were continued under satisfactory conditions until shortly after the middle of October. Beginning October 20 and lasting nearly a week the lake was swept by gales of such intensity as to result in an immense amount of damage to commercial fishing equipment; and, after the winds subsided, it was found that all the lake trout which had congregated on the reefs had left that portion of the lake, thus putting an end to the collecting season. From the 9,357,000 eggs taken, 6,603,500 fry were developed and planted in the Michigan waters of the lake. In addition to 2,060,000 whitefish eggs of poor quality obtained in the vicinity of the Isle Royale fisheries, 3,400,000 green whitefish eggs were turned over to the station by the Michigan Department of Conservation. The two lots yielded approximately 2,800,000 fry, most of which were planted in Isle Royale waters. Cisco eggs to the number of 18,150,000 were received during November in the Bayfield (Wis.) field. A large percentage were inferior, and only 6,200,000 fry were hatched. Practically all of them were planted in the vicinity of Bayfield. Early in the winter the station received by exchange 200,000 eyed brook-trout eggs. From this stock 184,000 No. 1 fingerling fish were produced and distributed to applicants. Egg collections of pike perch were made in Minnesota waters in cooperation with the fisheries department of that State. The results were 10,000,000 eyed eggs from which 9,715,000 fry were hatched and distributed.

NORTHVILLE (MICH.) STATION AND SUBSTATIONS

[W. W. THAYER and FRANK L. SNIPES, Superintendents]

Fish-cultural operations in the Michigan field were on the whole very satisfactory. The aggregate output of the main station and its substations exceeded that of any previous year by 73,537,825. The increase consisted in the main of the larger numbers of whitefish and lake trout produced at the substations.

Northville (Mich.) station.—The output for the year in this field aggregated 1,309,800 fish, with approximately 193,000 rainbow trout and black bass on hand at the close of the year. Two hundred and forty-six thousand brook trout on hand July 1, 1929, were reared to the large fingerling size and distributed in the fall. In the early winter there were received from outside sources 1,282,000 eyed brook-trout eggs. Losses during the incubation and fry periods totaled 521,999, leaving for distribution during the spring 746,100 No. 1 fingerlings. These were used for supplying applicants in the surrounding region and for stocking three cooperative nurseries in Michigan. One hundred and eighty thousand rainbow-trout fry, on hand when the year opened, were distributed shortly afterwards. Eggs of this species numbering 302,000 were received during the year. Seventy-five thousand were reshipped to other stations; the remainder were incubated, producing 227,000 fry of which 51,600 were utilized in filling applications, leaving 143,500 advanced fry on hand at the end of June, 1930. The stock at that time also included 4,500 No. 1 fingerling land-locked salmon. These were the result of 10,000 eggs shipped in from the Craig Brook (Me.) station.

The spawning of 65 smallmouth black bass in one of the station ponds, furnished for distribution 36,000 advanced fry and 59,700 No. 1 fingerlings; and when the year closed there were approximately 35,000 young bass in the pond. One hundred and fifteen adult smallmouth bass received from the Lake Erie field were divided between two ponds, one being 0.52 of an acre in area and the other 0.63. Soon afterwards a number of dead bass were noted in these ponds. Very few nests were observed and neither of the ponds yielded any young fish for distribution. The most important item in the line of improvements during the year was the construction of a modern 8-room cottage for the use of the station fish-culturist.

Charlevoix (Mich.) substation.—A total of 40,218,000 lake trout eggs were handled at this hatchery, with an approximate increase of 30 per cent in fertilization over that previously attained. Throughout the season test lots of the eggs supplied by various fishermen were kept with the view of determining the quality furnished by each man. The rate of fertilization of eggs from one collecting field, namely, Leland, Mich., was found to run as high as 98 per cent, while those received from other ports ranged from 60 per cent to as low as 7 per cent in fertility. On completion of the tests each fisherman was informed of the results, and it is hoped that all of them will hereafter exercise care in taking the eggs in an effort to furnish spawn of superior quality for the propagation work. For the second time since the work was inaugurated in this field the station batteries were filled to capacity with whitefish eggs; and, after installing all that could be cared for therein, a large excess on hand was transferred to the Alpena hatchery. Incubation was completed at the unusually early period of February 20, and as the lake at that time was filled with ice, the use of cars had to be resorted to for making the distribution. The work was satisfactorily accomplished by means of the bureau's car No. 9 assisted by the Michigan State car "Wolverine." Among the more important improvements during the year were the painting of the hatchery building and the thorough overhauling and cleaning of the filtering plant. Two new fry tanks were built, and at the close of the year the aquaria room was being placed in condition for the maintenance of an exhibit during the summer.

Alpena (Mich.) substation.—Three factors operative in this field, and nullifying to a considerable extent the efforts in connection with the propagation work, were the comparatively poor quality of the whitefish eggs received, unfavorably low water pressure in the hatchery, and an injurious amount of chlorine in the water supply at the time the pike-perch eggs were undergoing incubation. Good weather prevailed at the opening of the whitefish spawning season but unusually severe storms set in soon afterwards, practically wrecking all fishing nets operating in the region. Taken under such conditions the quality of the whitefish eggs could hardly be rated higher than fair. After reaching the eyed stage 2,000,000 of the 71,000,000 secured were forwarded to the Lincoln Park Aquarium at Chicago, Ill. In connection with lake trout propagation, encouraging results were attained in an effort to rear the fry at a nursery located at Rogers City, Mich. An output of No. 2 and No. 3 fingerling lake trout numbering 268,500 and 170,000, respectively, was produced, and at the close of the year 245,000 No. 1 fingerlings were still on hand in the nursery. During April 89,620,000 pike-perch eggs were received from a collecting field operated by the State near Bay City, Mich. They appeared to be of fair quality, but, owing partly to the low-water pressure and partly to the presence of an unusually strong solution of chlorine in the city water supply, the output of fry amounted to only 5,000,000. All of these were planted in adjacent public waters.

Material assistance was received from the Michigan Department of Conservation in connection with the distribution of whitefish and lake trout. As in past years the Detroit & Mackinac Railroad Co. cooperated with the bureau in the carload shipment of fish for planting at various points. The fishermen of the region also rendered valuable aid and hearty cooperation in connection with the distribution and planting of the fish. The fishermen generally are very optimistic concerning the fishing outlook for next year, as great numbers of immature whitefish and lake trout are in evidence. A phenomenal catch of whitefish was made late in June, 1930, one net operating about 6 miles from Epoufette, Mich., taking 3,326 pounds.

PUT IN BAY (OHIO) STATION

[DAVID DAVIES, Superintendent]

The whitefish spawning season on Lake Erie opened on November 7 and on November 29 was brought to an early and abrupt close by a sudden cold snap which froze the surface of the lake and prevented further operations of the commercial fishing nets. Nothwithstanding the unusually brief egg-collecting period, 71,240,000 were taken, this amount slightly exceeding the take during the fall of 1929. Very satisfactory results were attained in the propagation of pike perch during the spring of 1930. The aggregate egg collection amounted to 316,275,000, being nearly three times the number secured the previous year. Incidental to this work 1,250,000 yellow-perch eggs were taken and incubated. Owing to high-water stages very few carp were taken at the fisheries operated in the Portage River and Sandusky Bay, and while all available eggs were secured, the season's total amounted to only 3,250,000. During the year needed repairs were made to the station boilers and pumps, and all batteries and steam and water pipes were repaired and painted. The gas boat was overhauled, and painted inside and outside. New furnace lining and boiler fronts were placed on the *Shearwater* boiler, and changes were made on water pipes of deck pump. The hull of the boat was scraped and painted.

CAPE VINCENT (N. Y.) STATION AND SUBSTATIONS

[J. P. SNYDER, Superintendent]

A supply reservoir, 75 by 75 feet in dimensions and 7 feet deep with concrete retaining walls, was completed during the year; and four bass ponds, each exceeding an acre in size, were nearly completed. A new trout nursery consisting of a hatchery, office, meat house, four ponds, and some open-air troughs was constructed during the year near Gracy, N. Y. This establishment is being operated in conjunction with Cornell University management, and in addition to the production of several hundred thousand trout during the year it was used as a base for the conduct of various feeding, rearing, and other experiments under the supervision of Dr. G. C. Embody of the university. In addition to the substations referred to below, the Cape Vincent station supervised the work of cooperative nurseries located at Adams, Malone, Arena, and Oneonta, all in New York State, and at Averill, Vt. The combined output from these projects amounted to 168,120 fingerling and yearling trout, and 228,000 trout of various sizes were in stock at the end of the year.

The unusually small egg collections of commercial species secured for stocking the Cape Vincent hatchery were made under very discouraging conditions. By a decision of the Ontario fisheries authorities the prolific egg-collecting fields along the north shore of Lake Ontario were no longer accessible to the bureau, while unusually severe storms in New York waters of the lake prevented the lifting of nets for a period of 10 days just at the height of the spawning season. This storm period was followed immediately by intense cold, causing all bays to freeze over and necessitating the discontinuance of commercial fishing for the season. In the face of such an outlook whitefish and cisco egg collections were reduced to 1,236,000 and 57,340,000, respectively, while less than 2,000,000 lake trout eggs were taken. During the spring spawning season 6,300,000 pike-perch eggs and 3,000,000 yellow-perch eggs were obtained and incubated. The station received from outside sources the usual number of brook trout, rainbow trout, and Loch Leven trout eggs to cover distribution requirements in New York and adjacent territory.

Watertown (N. Y.) cooperative substation.—The facilities at this substation were improved by the provision of additional hatching troughs and the construction of a cottage. The output consisted of 449,750 trout fingerlings Nos. 2 and 3, and 780,826 trout of different species were being carried in ponds and troughs at the close of the year.

Barneveld (N. Y.) cooperative substation.—As in past years the fish-cultural work at this substation was under the joint supervision of the bureau and the Utica chapter of the Izaak Walton League. Its output of fish consisted of 129,125 brook and rainbow trout of various ages, and 226,389 trout fingerlings and yearlings were on hand as the year closed.

Ithaca (N. Y.) substation.—This project was constructed in the course of the past fiscal year, but it has had no output as yet. On June 30, 1930, there were on hand 194,072 trout of various sizes.

Swanton (Vt.) substation.—The run of pike perch was disappointing and only 63,800,000 eggs of that species were taken. The collections also included 94,380,000 yellow-perch eggs and 6,750,000 of the white sucker, the latter being obtained for the Pennsylvania Fish Commission.

RESCUE OPERATIONS

Water conditions in the upper Mississippi River field were such that the salvage of stranded fishes from the overflowed areas resumed its rôle as one of the most important activities of the La Crosse (Wis.) field headquarters. The work was started during the month of August and carried on into November, and the total collection of over 146,000,000 fish represents slightly above an average or normal season's work in this field. The seasonal nature of this activity renders it possible for the station's personnel to be utilized in widely varied fields such as the propagation of the commercial species of the Great Lakes and the propagation and distribution of trout in Minnesota and Wisconsin. Cooperative fish-cultural work carried on in conjunction with the sportsmen's organizations in the near-by territory has become one of the most important activities in this field, taking a large number of the output of trout of the La Crosse station and requiring extensive supervision.

LA CROSSE (WIS.) STATION AND SUBSTATIONS

[C. F. CULLER, in charge]

Rescue work on the upper Mississippi River was begun on August 7. Twelve crews were engaged in the work which was terminated on November 19. Over 146,000,000 fish were rescued, of which approximately 490,000 were reserved for distribution elsewhere. The cost of the rescue work was approximately $0.11 per thousand fish handled. In connection with the rescue operations, mussel-infection work was performed and over 1,900,000,000 glochidia were released in a state of parasitism on rescued fishes.

The chief construction work was the erection of dwellings for the district supervisor and superintendent. An artesian well was drilled on the Upper Mississippi Wild Life Refuge grounds adjacent to the station, furnishing a flow of 150 gallons a minute. Trout culture was carried on successfully at the main station, and the Northside station and Lynxville station were operated to care for the overflow. Brook, rainbow, and Loch Leven trout were the species handled. Cooperative rearing ponds supervised by this station numbered 91 in Wisconsin and 24 in Minnesota. Further efforts were made to develop bass-rearing projects. The personnel of the station was detailed to various duties in the field during the year, including the fish-cultural operations in Yellowstone Park, Miles City, Mont., and in Michigan, together with the cooperative work in the State of Arkansas.

Bellevue (Iowa) substation.—A new holding station was constructed here on the property of the Wild Life Refuge, and the water supply was obtained from an artesian well providing a flow of 300 gallons per minute. This furnishes the bureau with a very efficient plant for holding rescued fish prior to distribution. During May and June collections were made of buffalofish eggs and carp eggs. The total collection of rescued fish in this field was 35,614,000.

Marquette (Iowa) substation.—While no construction or other important work was undertaken during the year, successful rescue operations were conducted from this point and over 4,000,000 buffalofish eggs and 3,875,000 eggs of the carp were collected and planted in the Mississippi River. Mussel-infection work was also conducted and 26,835,000 fish were rescued.

Lynxville (Wis.) substation.—During the hatching period for trout this station was used as a temporary holding plant for the surplus from La Crosse. In addition to the ordinary rescue work, collections of brood fish for stocking ponds were made in this field, and from this point aquarium specimens and fishes for scientific investigations were collected and shipped. This is one of the most prolific fields, and the total number of fish handled exceeded 40,000,000, with a considerable number of carp and buffalofish eggs having been fertilized during the spring.

Homer (Minn.) substation.—Fish-cultural work at this point consisted entirely of rescue operations. The station, however, was used as headquarters by the investigating staff conducting biological studies in the Upper Mississippi Wild Life Refuge. It was used, also, for the construction and overhauling of vessels and the overhauling and repair of automotive equipment. One 32-foot launch was constructed at this point, and a smaller boat was built for local use. The total number of fish handled in the rescue work was 22,225,000.

UPPER MISSISSIPPI WILD LIFE AND FISH REFUGE

The following report is submitted covering the biological investigations in the Upper Mississippi Wild Life and Fish Refuge:

Detailed quantitative biological studies of five sloughs in the vicinity of Trempealeau (Wis.) and Winona (Minn.) were made at 2-week intervals throughout the year, summer and winter. Studies were made of bottom and weed fauna populations, plankton, and chemical conditions. These observations in a general way revealed that these sloughs differ widely in production of natural food, that the bottom and weed fauna populations are apparently composed of few species but large numbers of individuals, and that the character of the bottom of a slough can be used in predicting the quantity and diversity of food it contains. Oxygen samples, taken in winter beneath the ice, showed that the oxygen supplies of the sloughs investigated were exhausted by the end of January. This condition would not permit the holding of fish in them through the winter, though river stages would usually permit it. Since all fish landlocked in sloughs are likely to die before the end of January, and since it appears to be impossible to rescue all large fish in them, it would seem advisable to permit early winter fishing in them, provided such fishing would not result in illegal fishing in waters open to the river. Complete analysis of the data collected in these studies will not be possible for several months.

Fish population records of all sloughs seined thus far in our operations show that the pickerel is the most important fish enemy of game fish in the sloughs. Legislation permitting the taking of pickerel 20 inches or more in length by commercial fishermen within the refuge limits would probably result in an increase in the numbers of other species of more desirable game fish.

In fish-cultural practice in the sloughs, screens should be put in and the pickerel removed as soon as the ice goes out in the spring and a favorable river stage permits. Although this was done in the spring of 1930, it probably will not be possible to remove the adult pickerel before they have spawned. In the latter case the seining of the sloughs, which are to be used as rearing ponds for bass, would have to be postponed until just before the bass fry are planted in them.

Examination of river-stage records for this locality shows that the Mississippi River in recent years seldom exceeds the 6-foot stage during the last week in May and throughout June. This will make possible beyond doubt the production of fingerling bass running into the hundreds of thousands in sloughs in this locality, though some years are going to be comparative failures. During the current year 135,000 bass fry were transferred to sloughs prior to June 30. The exprimental results from these plantings will be affected to an uncertain extent, however, by two rises exceeding the 7-foot stage at Trempealeau during the critical period.

Experience during the current year has shown that bass fry less than five-eighths of an inch long apparently exhibit strong negative rheotropism. Losses of fry from our large brood pond were experienced when fry passed through the meshes of the screens (7 meshes to the inch) used to shut the pond off from a slough below connecting it eventually with the river. These losses occurred when the river was dropping rapidly or a current was passing through the pond during high-water periods. Precautions will be taken during another season to place our brood stock in sloughs from which there is no outflow or appreciable passing through.

Experiments in the control of vegetation with sodium arsenite solution were made during the summer of 1929. It was found that amounts of the chemical up to about 1.7 parts per million arsenious oxide could be used with good results without exterminating microscopic or macroscopic fish food organisms. The chemical was applied to the sloughs believed to need treatment early in spring, during a low-water period, before rapid development of vegetation had gotten under way.

In further connection with the bureau's operations a 3½-acre tract in the refuge adjoining the La Crosse hatchery was cleared for the purpose of constructing a bass pond to be supplied with artesian water. A number of inspections were made throughout the refuge for the purpose of locating sites suitable for bass culture, but it was found that those most satisfactory had not yet been acquired by the Government.

MARINE SPECIES

As has been previously stated a considerable proportion of the increase in the total output of fish and eggs for the fiscal year is attributable to augmented production at the marine stations. Five species only are handled, constituting the forms which are the basis of the most profitable inshore fisheries in the New England area. Changed conditions in the vicinity of the Woods Hole (Mass.) station have rendered it increasingly difficult to obtain a supply of cod eggs, and work at this point was concentrated upon the propagation of the winter flounder. The Gloucester (Mass.) station also had a reduction in its output of cod and haddock, but the work of the Boothbay Harbor hatchery was very successful in all its ramifications.

BOOTHBAY HARBOR (ME.) STATION

[THOMAS H. DOOR, Superintendent]

During that portion of the year when no fish-cultural operations were possible, the station force was employed in making needed repairs to the house occupied by the engineer and other buildings, and in the maintenance of the station aquarium. Two, and frequently three, men with the bureau's launch were engaged in collecting exhibit material; and specimens of every species that could be secured, together with four young seals, were transferred to the station and placed on exhibition in the aquarium and in live cars.

The fish-cultural work consisted as heretofore in capturing brood winter flounder, taking and developing the spawn, liberating the fry, and in stripping, fertilizing, and planting on the natural spawning grounds such cod and haddock eggs as were available at commercial fisheries within reach of the station. With the aid of a temporary force and a chartered power boat to assist the bureau's launch, a total of 96 fyke nets were set in all bays and coves from Johns Bay to Robin Hoods Cove within a radius of 12 miles of the station. At the close of fishing in one place the nets and operations were transferred to another. Working in this way a total of 12,798 brood fish, or 3,000 in excess of the take last year, were captured between March 5 and April 15, and from them 2,625,942,000 eggs were secured and developed, yielding an output of 2,434,538,000 fry for liberation on or near the areas from which the eggs were derived. Work with this species came to an end on April 25. With the opening of the cod season on April 1 a second boat was chartered and, as soon as the winter flounder season had ended, both boats were detailed to the cod work until the height of the collecting season had passed, when the services of one was discontinued. By means of the three boats available all grounds between Pemaquid and Seguin Islands were covered and at the close of operations on May 28 a total of 1,068,142,000 cod eggs and 124,920,000 haddock eggs had been handled. The work with the former species established a record achievement for this station.

GLOUCESTER (MASS.) STATION

[C. G. CORLISS, Superintendent]

This station began active fish-cultural work on November 1 with the acquisition of the first lot of pollock eggs. Collections of these eggs came in at intervals up to the end of January. The total for the season amounted to 1,028,433,000, and from this stock 616,713,000 fry were produced. This output represents a material increase over the results attained in previous years. Of the total collection of 657,722,000 cod eggs secured 307,737,000 were incubated, yielding an output of 229,769,000 fry. The remainder of the collection were planted as green eggs on the fishing grounds, the low density of the water from which they were derived making their transfer to the hatchery impracticable. Haddock fishing on inshore grounds was so poor throughout the spring that only one or two boats were engaged in it. The season's egg collections of this species approximated 135,385,000 of which 38,018,000 were, on account of low water density, deposited as green eggs in the fishing areas where taken. From the eggs handled in the hatchery 63,168,000 fry were developed and planted. Winter flounder operations were conducted between March 4 and April 30. From a brood stock of 350 fish 175,072,000 eggs were produced and 159,972,000 fry hatched and liberated. The offshore operations were prosecuted from February 1 to April 12. During this time 43,106,000 cod and 57,406,000 haddock eggs were handled. These numbers represent a decline as compared with last year's results in this field.

WOODS HOLE (MASS.) STATION

[G. R. Hoffses, Superintendent]

Changing conditions in the local commercial fishery have made it increasingly difficult to obtain cod eggs for incubation. The once prolific collecting fields at Sandwich and Plymouth, Mass., are now entirely closed to such work; and of late years the station has been dependent on the comparatively small local hand-line cod fishery, conducted from small boats manned by one or two men, and two or three traps owned and operated by parties from Newport, R. I. From these sources it is the practice to select such fish as give promise of the greatest egg production and hold them in a pool at the station pending natural spawning. The eggs thus secured are transferred to the hatchery and incubated by the usual method. Experience having shown that fish taken in the traps invariably are superior as prospective spawners to hand-line fish, effects to obtain brood cod are always directed first to the traps. During the past year, however, all traps available in this region took nothing except small immature fish unsuitable for fish-cultural work. From the hand-line fishermen only about 100 cod were collected and nearly all of them proved to be males or barren females. The amount of eggs secured, therefore, was negligible.

The results of the work with winter flounder were entirely satisfactory. Fishing for brood fish of this species continued from January to March and 2,380 females were handled, producing approximately 837,000,000 eggs. The apparently early spawning of winter flounder in Waquoit Bay is mentioned as being of passing interest. The first take of fish in the station nets on January 11 contained spent females. In all previous years all fish taken on or about that time have been held in tanks for a period of one to two weeks awaiting the maturity of their sexual products. During the spring and early summer 17,500,000 mackerel eggs were obtained from the local trap fishery. Scup were also in evidence in the catches, though practically none was in spawning condition. A deaerating device installed in the sea-water tank has proven of real value in reducing the mortality of fish carried for public exhibit or in connection with fish-cultural work.

Offshore spawn-taking operations did not result successfully from the standpoint of eggs fertilized. Being unable to obtain the services of skilled spawn-takers for the work, four inexperienced men from the station personnel were detailed to the offshore field. The experience gained by these men may be of value to the station in connection with next season's operations.

ANADROMOUS SPECIES ATLANTIC COAST

All operations under this classification were materially restricted. The production of shad at the Fort Humphreys (Va.) and Edenton (N. C.) stations was negligible, and no striped bass eggs were obtained at the Weldon (N. C.) substation. The Craig Brook (Me.) station handled 1,000,000 Atlantic salmon eggs secured by exchange but allotted the major portion of them to the State hatcheries where more adequate facilities for rearing the fingerlings were available. The propagation of yellow perch on the Potomac River yielded an output of normal proportions.

FORT HUMPHREYS (VA.) SUBSTATION

[CHARLES W. BURNHAM, Superintendent]

A total of 3,629,000 shad eggs was collected and the 2,120,000 fry produced therefrom were liberated on adjacent spawning grounds in the Potomac River. The shad spawning season of 1930 was one of the poorest ever known for the collection of eggs in this field. A comparatively slight rainfall during the spring caused the river water to become so brackish that hard crabs could be caught in large numbers from the station wharf. Under such conditions the run of shad was necessarily light and only a small proportion of the fish were ripe. From a brood stock of approximately 24,700, yellow-perch eggs to the number of 88,920,000 were secured from which 80,050,000 fry were developed. All of these were planted in the river at points where the brood fish had been taken with the exception of 20,780,000—the latter being used for stocking other waters, chief among them being tributaries of the Potomac. Eggs of the yellow perch are obtained by holding the adult fish in wooden crates in the river until they spawn. The adults are then liberated and the eggs are collected and developed in hatching jars. Any excess eggs left after filling the hatchery to capacity are hatched in wire baskets anchored in the river.

The most important improvement during the year was the installation of electric wiring about the grounds, the wiring of all buildings, and the installation of electric lights therein. This work was completed during the month of March, in advance of the season's fish-cultural operations. For the purpose of holding up the earth embankment, a concrete wall, 3 feet high and 8 inches thick, was built along the walk to the main buildings for a distance of about 300 feet. Considerable work was done on the road leading from the top of a steep hill to the station buildings. A pond fed by water from a small spring was formed by damming a ravine near the superintendent's residence. A lot of brook trout 1½ inches in length were installed in the pond as an experiment. After remaining therein for a period of two months and receiving a regular ration of beef heart they appeared, at the close of the fiscal year, to be in excellent condition.

EDENTON (N. C.) STATION AND SUBSTATION

[WILLIAM S. VINCENT, Superintendent]

The propagation of commercial species was conducted as in former years, but the results were considerably below the average. In the case of the shad this was due partly to scarcity of fish in spawning condition in the single collecting field available for the work and partly to the inferior quality of the eggs secured. A large percentage of the mature females were found to be overripe and, under such conditions, the eggs can not be fertilized. Only about 3,000,000 shad eggs were secured, and all of the fry developed from them were planted in the vicinity of the collecting ground at the mouth of the Chowan River. Continuous adverse winds and cold weather during February prevented a normal collection of brood yellow perch before the spawning season had begun and only about 400 females with eggs could be obtained. These were placed in one of the station ponds to spawn and produced approximately 3,000,000 eggs, the fry from which were utilized for supplying applicants and for the restocking of local public waters. Unripe herring in vast numbers appeared on the fishing grounds near the station some three weeks earlier than usual, the run continuing for over a week. On account of the prevailing low temperatures, however, but few of the fish were in spawning condition, and only 30,000,000 eggs were collected. The 10,000,000 fry produced as a result of the work were planted in local waters.

A decided improvement was effected by the erection of a 6,000-gallon steel water tank on a 12-foot tower for the storage of hatchery water and the demolition of the old wooden tank. The latter had been in service for over 30 years, and on account of its prominent location, it detracted greatly from the general appearance of the station.

Weldon (N. C.) substation.—The striped-bass station at this point was opened on May 1, and placed in condition for active operations. On account of low-water stages in the Roanoke River, however, very little successful fishing was possible and no eggs were available. The station was closed on May 17. The moderate expense incurred in this field was partly defrayed by the North Carolina Department of Conservation, in accordance with the practice of recent years.

CRAIG BROOK (ME.) STATION

[GEORGE N. MONTGOMERY, Superintendent]

In accordance with an existing agreement, this station received 1,000,000 Atlantic salmon eggs from hatcheries under the control of the Canadian Government. Of this stock two consignments of 20,000 eggs were supplied to the States of Pennsylvania and California; 125,000 were transferred to the Grand Lake Stream auxiliary for development, and 715,000 were turned over to hatcheries operated by the State of Maine, with the understanding that the resulting fish would be held and fed for a period of two years and then liberated in waters directly connected with the Atlantic Ocean. The fish developed from eggs retained at the station numbered approximately 90,000 at the close of the year. The station's distributions of this species during 1930 consisted of 106,400 large fingerlings carried over from the hatch of the previous year and liberated during September in tributaries of the Penobscot River. Ninety-seven thousand fingerlings, derived from eggs turned over to the Maine fisheries authorities by the bureau last year, were also liberated from hatcheries operated by the State. As was the case last year, the weir fishermen of the region were interviewed as to the status of the salmon fisheries. All reports received were favorable though the fish were said to be running somewhat small in size. On the whole, salmon fishing on the Penobscot River is considered to be good, though pollution conditions exist that are tending to reduce the number ascending the river each year.

FISHES OF MINOR INTERIOR WATERS

By far the greater proportion of the existing hatchery facilities in this country both State and Federal, is directed toward the propagation of the game and semicommercial species indigenous to the lesser waters of the interior section. It has been clearly demonstrated by private clubs that the continuous restocking of a given body of water with game varieties will assure the perpetuation of first-class angling. The State and Federal hatcheries in distributing trout, bass, and other game forms direct to public applicants, or in making plants from the hatcheries, serve as a basis of supply for restocking strictly public waters in the same manner as privately controlled waters are administered. In view of the increasing tendency of private individuals and organizations to purchase or lease control of desirable fishing waters, the public welfare demands increasing efforts on the part of Government agencies to provide equally good fishing in the lakes and streams which still remain accessible to the public. The problem involved in this work has widely divergent aspects. In the more populous centers the situation has reached a point where practically every fish which is to be caught must be planted from some hatchery, since the factor of natural reproduction is negligible. On the other hand, in the Western States the planting of large numbers of trout is a means of supplementing the natural reproduction and forestalling the depletion which has occurred in other areas. The distribution of the product of a single hatchery over a wide area, sometimes comprising several States, does not permit plants of fish adequate to effect a real improvement at any particular location except in the case of the Southern States, where a newly constructed artificial pond or lake may be supplied with an initial stock. The ideal to be attained and to which progress is constantly being made, is the establishment of a hatchery for each outstanding fishing area or stream system, the output of which is to be devoted to restocking local waters and not distributed over a great expanse of country.

ROCKY MOUNTAIN TROUT STATIONS

The Rocky Mountain stations and their substations have a large capacity for the production of trout and are carrying on field operations which yield large collections of eggs from wild fish annually. The surplus trout eggs so secured are transferred to others of the bureau's stations after the requirements of the parental waters are met. The western trout stations must meet a dual demand since they are called upon for extensive plantings of fish in the public domain, particularly the national forests and national parks, in addition to supplying fish to the individual angler or sportsmen's groups in the usual manner.

BOZEMAN (MONT.) STATION AND SUBSTATIONS

[W. T. THOMPSON, Superintendent]

The Bozeman station and its auxiliaries experienced a very prosperous year and succeeded in establishing a new record in almost every line of endeavor. The total number of eggs handled by this group of stations amounted to 30,675,070. The distribution resulting therefrom numbered 24,558,645, and a total of over 6,000,000 eggs, fry and fingerling fish were on hand at the close of the year.

Bozeman (Mont.) station.—The station enlarged its rearing operations to the extent that 24 carloads of choice fingerling fish were produced for general distribution in addition to the considerable numbers utilized in supplying near-by applicants and making local public plants. No brood stock is maintained at Bozeman. In the course of the year, 1,197,200 rainbow trout eggs and 10,256,550 Loch Leven trout eggs were transferred there from the Meadow Creek (Mont.) field, largely for the purpose of eying and shipping on assignment. There were also received from other stations of the bureau 550,000 fall-taken Missouri rainbow eggs, 49,020 black-spotted trout eggs from domesticated stock reared at Pittsford, Vt., 573,000 black-spotted trout eggs from wild fish of the Yellowstone Park, and 132,000 brook-trout eggs from Springville, Utah, making a total of 1,304,020 eggs obtained by transfer from outside stations. There were also received through the medium of exchange 109,000 rainbow-trout eggs, 2,474,900 black-spotted trout eggs from the Montana Department of Fish and Game, and 10,000 golden-trout eggs from the California Fish and Game Commission. The above made a total of 2,593,900 eggs received by exchange and a grand total of 15,351,670 derived from all sources.

The station continued its experimental work in the feeding of liver-meat meal, prepared from horse flesh, to young fish in hatchery troughs, and the value of this material for the rearing of trout up to the No. 3 fingerling stage was successfully demonstrated. It is considered that the station's greatest contribution to fish-cultural information during the year was the success attending its experimental work for the purpose of ascertaining the proper water temperature and other conditions requisite for the production of choice Loch Leven trout fingerlings. This problem has now been largely solved. As in the past, harmonious relations were maintained with the Montana Fish and Game Commission. In the course of the year that organization supplied green eggs to the Meadow Creek substation. These were incubated and reared to the planting stage and then planted in suitable State waters in cooperation with the State officials.

Meadow Creek (Mont.) substation.—At this point record collections of rainbow trout and Loch Leven trout eggs were made, the numbers amounting to 4,120,800 and 18,379,400, respectively. An initial collection of 44,000 black-spotted trout eggs was made as a result of recent development efforts. A total of 1,617,200 rainbow eggs were transferred to Bozeman and Glacier Park and 600,000 were shipped on assignment—all being reported as received in excellent condition. Fingerling rainbows to the number of 1,183,400 were planted in Madison Valley waters, and 1,051,400 remained on hand at the end of the year. Loch Leven trout eggs to a total of 10,256,500 were transferred to the Bozeman field, 4,007,100 were shipped to applicants, 3,676,200 fry and fingerling fish were planted in Madison Valley waters, and at the end of June, 1930, 50,000 fingerlings were on hand at the station. The total of the above shows an output of 95½ per cent of the eggs collected.

Glacier Park (Mont.) substation.—From the hatchery in this field 391,700 rainbow and 802,150 black-spotted trout fingerlings, together with 70,500 fry and 51,000 eggs of the latter species, were delivered to the Glacier National Park Service for planting in national park waters. The eyed eggs were utilized for stocking distant virgin lakes difficult of access. Forty-four thousand eight hundred golden-trout eggs, received through the courtesy of the California Fish and Game Commission, were planted in Lake Wurdeman near the Canadian border. In addition to the above there remained in hatchery troughs and ponds at the close of the year 476,380 rainbow fry and 994,320 black-spotted trout eggs. The facilities at this substation were increased during the year by the completion of eight large rearing ponds and the construction and installation of a new battery of troughs. A new water supply was also provided.

FIGURE 2.—Taking trout eggs at a field egg-collection station

Miles City (Mont.) substation.—This new substation was operated in conjunction with the Montana Fish and Game Commission on an equal share basis. The results were very encouraging notwithstanding the unsatisfactory conditions brought about by the long spell of hot dry weather, which lowered the water level of the lake to such an extent that less than one-half its feeding area was available at the time when it was most needed. The output from this field comprised a total of 274,025 largemouth black bass, crappie, sunfish, and perch. The harvesting of the fish was rendered difficult by the fact that the middle portion of the lake could not be drained thoroughly, thus entailing a considerable amount of seining which had not been contemplated. In cooperation with the Montana commission, a residence for the caretaker, a large tank and sorting house, and a small garage were constructed after the close of the distribution season. A supply ditch was excavated and an independent pumping plant was arranged. With the view of making this substation a complete and independent pond unit capable of furnishing for car distribution all varieties of the pondfishes ordinarily desired, it is planned to construct an additional lake of smaller size than the one now in use for the production of such species as catfish and yellow perch.

LEADVILLE (COLO.) STATION AND SUBSTATION

[C. H. VAN ATTA, Superintendent]

A lumber shed 20 by 36 feet in dimensions was built for the storage and seasoning of green lumber sawed by the station mill. Double doors were made for the 7-stall station garage, and doors for the garage at the Creede substation were built here. All necessary repairs were made on the station buildings and grounds. The drainage ditch back of the hatchery was widened and deepened throughout a distance of 500 feet. A new electric generator was purchased for the station lighting plant and put in operation. Eyed rainbow-trout eggs numbering 484,570 were received from Seattle, Wash., in exchange for brook-trout eggs and 150,400 eyed black-spotted trout eggs were transferred to this point from the Yellowstone Park. The year's output of fish, comprising 3,575,500 brook trout, 459,500 rainbow trout, 65,800 black-spotted trout, and 102,000 Loch Leven trout, was distributed by means of the bureau's car No. 8. The usual brook-trout egg-collecting stations were operated at the Mount Massive Club Lakes, Turquoise Lake, and Wurts Lakes in accordance with the percentage basis formerly agreed upon, and a total of 3,756,000 eggs were taken. On attaining the eyed stage 100,000 of these were shipped, and from the remaining stock 3,369,800 fry were hatched. About 1 acre of mud and silt was removed from Crystal Lake during the fall of 1929.

Creede (Colo.) substation.—The work of constructing this substation was undertaken in September, 1929. By November 22 the hatchery was put in operation, and in the course of the fiscal year a garage and carpenter shop were completed, the foreman's cottage inclosed, a road built from State highway No. 149 to the hatchery, and the hatchery water supply was placed in readiness for fish-cultural work. Brook-trout eggs to the number of 1,039,000 were received from a private hatchery and from Mason Lakes, Colo., to be developed on a percentage basis. From this stock 841,000 fish were hatched and 608,360 were distributed by the station truck before the end of the year. Eagle Nest Lake, N. Mex., and the Trinchera and Continental Reservoirs, in Colorado, were worked during the spring of 1930 for eggs of the rainbow and black-spotted trout. A total of 1,064,000 rainbow eggs were collected at Eagle Nest Lake and Trinchera Reservoir, and 854,600 eggs of the black-spotted trout were secured from the Continental Reservoir.

YELLOWSTONE NATIONAL PARK (WYO.) SUBSTATION

[C. F. CULLER, in charge]

Field operations at the Yellowstone Park substation overlapped two fiscal years, and the data herein supplied cover the summer season of 1929, or parts of the fiscal years 1929 and 1930. Collections of black-spotted trout eggs at this point numbered 18,871,000 during the fiscal year, and for the entire season, 14,656,000. As usual the personnel was recruited by detail from other stations. The cost of producing eggs was $0.138 per thousand for green eggs and $0.153 per thousand for eyed eggs.

A hatchery building containing an aquarium, with seven large exhibition tanks, was virtually completed. A mess hall was also constructed and work was inaugurated on a dormitory building. All buildings are of rustic log frame construction in harmony with the surroundings and the general style of architecture in the park. Necessary changes in the hatchery water supply were also made to accommodate the new building. One new motor boat was supplied. Experiments were made with an iron fish rack designed to overcome the difficulties arising from the common wooden racks being frequently washed out by high water in the streams. A new section was built on to the hatchery dock.

The first eggs were secured on June 7, and unusual conditions tended to restrict the collections somewhat below previous records. The streams rose during the first few days in June and thereafter failed to reach the normal or average flow. The lake was, likewise, some 20 inches below its normal summer height. While collections were more limited, the percentage of fertility was high, being over 96 per cent. Four ponds were used for rearing black-spotted trout to fingerling size at the hatchery, and the rearing ponds at Mammoth Hot Springs were stocked with rainbow, Loch Leven, and brook trout from the Bozeman (Mont.) station. During August excessive mortality developed and, on the failure of remedial measures, the surviving fish were distributed. The rearing ponds were also stocked with black-spotted trout fry which will be held for later distribution.

Reports again show extensive damage to fish traps and other property by bears. The destruction of the fish traps generally results in a loss of fish, since the bears are seeking them for food.

Experiments were made with the use of Great Lakes trap nets for the capture of adult trout near the outlet of the lake. A large number of fish were taken, but the work was initiated too late in the season to bring about the most effective results.

SARATOGA (WYO.) STATION

[S. M. AINSWORTH, Superintendent]

Using material purchased during the fiscal year 1929, a new nursery building 34 by 50 feet in dimensions was erected, thus increasing the station's hatching capacity from 36 to 101 troughs. A retaining wall was built along the earth bank ponds to prevent washouts and possible damage from burrowing animals. The electric-power line from the town of Saratoga, completed

FIGURE 3.—Setting trap nets to capture black-spotted trout for the collection of eggs. Yellowstone Park

and put in operation at the beginning of the year, is giving very satisfactory service. Completion of the work of painting all station buildings was accomplished in the summer of 1929. The collection of brook-trout eggs in the Big Creek Lakes field was far below normal, and, as their quality was somewhat inferior, the deficiency in stock was made up by the transfer of 557,000 eggs of excellent quality from the Springville (Utah) station. One hundred thousand No. 1½ fingerlings of this species were distributed during the spring and 500,000 fingerlings were on hand when the year closed. From the station brood stock of Loch Leven trout, 465,000 eggs were secured from which 420,000 fry were hatched. This lot of fish in the fingerling stage was carried over the end of the year.

The rainbow-trout egg collection in the Lost Creek field was below normal on account of low-water stages. In some of the streams there was not sufficient water to enable the fish to ascend to the traps and in such cases seining had to be resorted to at the mouths of the streams. The fish were larger than the average size and yielded more than the usual number of eggs per fish. Of the 1,709,000 collected, 409,000 were set aside to be hatched with the view of returning the product to their native waters. On reaching the eyed stage 247,000 of the remaining stock were transferred to the Saratoga hatchery and 657,000 were shipped to other stations. In connection with future operations in this field it is hoped to overcome the heavy losses of eggs which annually occur under present conditions by the improvement of a small spring near the hatchery for the development of eggs taken during the latter part of the season. By carrying out this plan the use of water which has seeped back into Lost Creek from irrigated meadows, where it has absorbed a large percentage of alkali, can be discontinued. The output of the station also included 440,000 black-spotted trout fingerlings—the result of eggs of that species furnished the station from Nevada and the Yellowstone Park field.

SPEARFISH (S. DAK.) STATION AND SUBSTATION

[D. C. Booth, Superintendent]

The large stock (upward of 600,000) of fingerling brook, Lock Leven, and rainbow trout on hand at the opening of the year was held in troughs and station nursery ponds until fall, and then given a wide distribution as Nos. 3 and 5 fingerlings. Nearly 1,400 transportation cans were required for the movement of these fish. Of course it would be possible to greatly increase the number of game trout distributed by making all shipments in April or early May, but it is believed that the results of distributing large fingerlings are of far greater value to the waters stocked. The holding and rearing of this large number of young trout was made possible by the recent installation of the wood-stave pipe line. During the year one of the larger ponds was subdivided into five very useful nursery ponds averaging 60 feet in length, 10 feet in width, and over 3 feet in depth. The bottoms of these ponds are of earth and the division walls, sides, and ends are of reinforced concrete. Each pond is provided with several inlets and outlets in the ends and sides, thus insuring a satisfactory water circulation. Young trout were placed in all these ponds in April, and by the close of the fiscal year only nominal losses had occurred.

Among other station improvements a bridge with concrete walls was built across a large storm channel, and wide concrete walks and a concrete roadway were constructed in front of the main fisheries building. For the first three years after this station was established an abundant supply of spring water was available, but the supply has since declined and, were it not for its high quality and low even temperature, it would not be possible to turn out the station's average of strong healthy trout. The maximum temperature of the spring water in the hatching troughs is 48° F., while the minimum averages 44° F. throughout cold winter periods. This low maximum may not be conducive to rapid growth, but there is no question that it produces strong healthy fish for distribution, and the troublesome diseases experienced at other stations are an unimportant factor at Spearfish station. The nursery ponds have a dual water supply with part of it being taken from the river and part from the cold spring. By such an arrangement the pond temperature usually ranges around 54° F., making possible a very satisfactory growth of fish. During the year considerable assistance was rendered to clubs, commercial fish-culturists, and individuals by solving complicated fish-cultural problems. Such assistance was given both personally and by correspondence.

Over 2,000,000 brook, Loch Leven, and rainbow trout eggs, obtained largely from station brood stock, were handled in the course of the year with merely nominal losses. Approximately two-thirds of a million eggs were secured from brood rainbow trout held at the station. Of these, 185,000 were assigned to the substation at Crawford, Nebr., and others were given in exchange for eyed brook-trout eggs for the Spearfish and La Crosse stations. A shipment of Loch Leven trout eggs was received from the Bozeman station and during January 400,000 brook-trout eggs were received by exchange. At the close of the year over three-fourths of a million brook, rainbow, and Loch Leven trout were being carried in station nursery ponds for late fall distribution as Nos. 4 and 5 fingerlings.

Crawford (Nebr.) substation.—Construction work connected with the establishment and development of this auxiliary was in progress throughout the year. A 1-story frame cottage, for the occupancy of the apprentice fish-culturist was built. The hatchery building was completed, troughs installed therein, and a supply of trout eggs was incubated during the winter. Work was started on the repair of Grabel Dam. The spillway was cut on the south side, cement side walls put in, and some work preliminary to the installation of a standpipe was accomplished. The ice pond dam, damaged by a recent flood, was repaired and the pond stocked with rainbow trout. At the close of the year a survey for a pipe line from springs at the pumping plant on the military reservation to the hatchery was being made, with the view of obtaining an auxiliary water supply for tempering the city water, which is too warm for trout in summer and so cold in winter as to retard the development of the eggs beyond the period where strong healthy fish are possible. In the course of the year the station received by transfer from other bureau stations approximately 170,000 eggs of the rainbow trout and 250,000 of the Loch Leven trout. In addition to this stock 200,000 brook-trout eggs were derived from a commercial hatchery. All of these were incubated and the fish reared to the fingerling stage before distributing them to applicants of the region. The year's output also included over 150,000 bream and smaller numbers of yellow perch and catfish, these fish having been collected from ponds in the vicinity.

SPRINGVILLE (UTAH) STATION

[CLAUDIUS WALLICH, Superintendent]

The following statement summarizes the fish-cultural achievements of this station during the fiscal year 1930 as compared with those of the preceding year:

	1930	1929
Egg collections	6,910,000	3,690,000
Egg shipments	1,797,000	364,400
Distribution of fingerling fish	1,622,000	1,407,100
Stock on hand at close of fiscal year	1,569,000	847,000

The rainbow trout work with station brood stock exceeded that of any former year in that 2,827,000 eggs of fine quality were taken. Egg collections at Fish Lake were 2,762,000 of the brook trout and 1,071,000 of the rainbow trout. Loch Leven trout eggs to the number of 374,000 were received from the Bozeman (Mont.) station of which amount 270,000 were turned over to the Utah Fish and Game Commission. At Pyramid Lake, Nev., 250,000 black-spotted trout eggs were taken. Eighty thousand of the 130,000 eyed eggs resulting from this collection are being reared at Springville and 50,000 at the Verdi, Nev., hatchery with the intention of returning the entire product to the Nevada lake next winter. Material assistance in the distribution of fingerling fish was received from the Utah Fish and Game Commission by placing at the disposal of the station the State's large fish tank truck. This was used in making four trips to Fish Lake, carrying from 125 to 150 quarts of solid fish on each trip, or a total of nearly 500,000 brook trout fingerlings Nos. 2 and 3 for return to the lake. The work at Pyramid Lake, Nev., hampered in its early stages by the hostility of resident Indians, was finally gotten underway with their tacit approval, and it is believed that continued sincere endeavors by the bureau to better fish life conditions at the lake will result finally in the development of an important egg-collecting field. The newly constructed concrete tank nursery was covered with a composition roof and equipped with dams, screens, etc. This nursery contains 96 tanks each 2½ by 2½ by 16 feet and is proving to be a most efficient acquisition. The additional water secured via the highway conduit from the east side also gives a much needed increase in the pond system supply.

NEW ENGLAND TROUT STATIONS

With the exception of the Nashua (N. H.) establishment all hatcheries in this group enjoyed a very successful season. The actual numerical output of trout in this field is much below that of the Western stations, but a larger proportion of the fish are distributed as good sized fingerlings to meet the special demands arising in this territory.

BERKSHIRE (MASS.) TROUT HATCHERY

[E. P. THOMPSON, Acting Superintendent]

Five wells and five well points were driven during the year, increasing the station's water supply by 84 gallons per minute. Both hatcheries, the garage, and the icehouse were painted on the outside, and the interior of the upper hatchery was given two coats. A new cement floor and 2 new cypress troughs were installed. Needed minor repairs were made to buildings and equipment, and electric lights were provided for in the fish-culturist's cottage. The station brood stock of brook trout yielded 700,000 eggs. Of these 250,000 were transferred to the Cape Vincent (N. Y.) station and from the remainder 340,915 young fish were hatched and reared to the fingerling stage with a merely nominal loss. The year's distributions included 318,000 brook-trout fingerlings and yearlings, 16,095 rainbow-trout fingerlings, 600 yearling catfish, and 400 yearling pickerel. At the end of June, 1930, there were being held for later distribution 78,180 brook trout, 200 catfish fingerlings, and 2,500 smallmouth black bass fry. Eighty-one thousand five hundred of the brook trout distributed were furnished for cooperative nursery work.

CRAIG BROOK (ME.) STATION AND SUBSTATION

[George N. Montgomery, Superintendent]

In addition to the collection of 2,421,450 brook-trout eggs from station brood fish, the Craig Brook station handled 180,000 eyed eggs of this species received through an exchange. Of the collected stock 975,000 eggs were shipped in the eyed stage to other stations of the bureau, and upward of 1,150,000 young fish were produced for distribution, this number including 351,850 large sized fingerlings carried over from the hatch of the previous year. At the end of June, 1930, 251,620 brook trout and 73,960 landlocked-salmon fingerlings were being carried in rearing ponds for distribution later in the season. This station is now in a position to produce all the brook-trout eggs necessary to meet its own needs besides supplying a reasonable quantity to cover outside requirements.

Grand Lake Stream (Me.) substation.—At the opening of the year approximately 490,000 fingerling landlocked salmon were being carried in rearing ponds. About 69,000 were liberated early in the feeding season to relieve crowded conditions and the remainder were distributed in September as fingerlings No. 3. Out of a collection of 592,970 eggs of this species obtained from local waters in November 120,000 were shipped in the eyed stage to applicants and 200,000 were transferred to the main station. The remaining stock produced 144,220 healthy fry. A few of these were distributed as fingerlings No. 1½ early in June and approximately 114,550 were being reared at the close of the year. Brook-trout fry to the number of 98,635 were derived from a consignment of 100,000 eggs transferred from the main station. Thirty thousand were distributed as fingerlings in May and June and the remainder were on hand at the close of the year. From a lot of 125,000 eyed Atlantic salmon eggs received from Craig Brook station in March 121,300 fry were developed. At the end of the year this entire lot were being held in the station ponds and fed.

In the course of the year needed repairs were made to racks and bulkheads and the bottoms of all ponds were newly sanded and graveled. Enough firewood was cut, hauled, and sawed to properly supply the hatchery and office needs. Stumpage was charged at the rate of $1.50 a cord.

ST. JOHNSBURY (VT.) STATION AND SUBSTATION

[A. H. Dinsmore, Superintendent]

Brook-trout eggs to the number of 994,764 transferred to this station from the York Pond (N. H.) auxiliary, 300,000 turned over to the station by sportsmen's organizations, and 556,609 purchased from commercial firms constituted the source from which the station's stock of brook-trout fry was derived for the usual distributions during the month of May. The entire output, consisting of 1,637,000 young fish, was distributed either by means of the station truck or by private cars whose owners called at the hatchery to receive their consignments. Extensive repairs were made on the superintendent's residence and the station power house during the year.

York Pond (N. H.) substation.—At this auxiliary, operated especially for egg production, 5,482,390 brook-trout eggs were taken. Of this stock 3,294,764 eggs were shipped to other stations of the bureau and approximately 750,000 were retained at the station for incubation. Shipments of fish resulting from these eggs to the amount of 345,053 were planted in local waters prior to the absorption of the sac, and the remainder were reared with the view of selecting the best among them for use as a future brood stock. At the close of the year the records showed 233,307 fingerling fish on hand, many of which were approaching the No. 3 fingerling size. This is by far the best record that the station has made.

Work along the line of improving and developing the station was prosecuted whenever fish-cultural operations would permit. Such development work consisted largely in the extension of the canal and pond system. A diversion dam and extensive flood spillway were constructed along the main West Branch and the canal way for approximately 1,000 feet to the valley of Diversion Brook; and during the winter, after the supply of wood for fuel was cut, cement material for the intake was hauled to the canal way and a considerable amount of grading was accomplished. Improvements to station buildings were continued and extensive repairs were made on the station power plant, iron buckets being installed in the water wheel and the dynamo practically rebuilt. In the course of the year two large ponds were completed, partially flooded, and put in commission for the retention of brood stock.

PITTSFORD (VT.) STATION

[Dr. H. S. Davis, Director; R. F. Lord, in charge]

A considerable portion of the time was spent in providing facilities for holding an increased stock of fingerling and adult trout. Six additional ponds and another 12-compartment raceway unit for experimental work were completed. Two of the fingerling ponds are of the circular type, insuring an efficient water circulation and a uniform distribution of the fish throughout the pond area. Arrangements were also made to lease additional land, which will permit of the construction of six small spring-water ponds for the wintering of fingerling fish. The general experimental work in relation to trout foods, selective breeding, etc., was very successful. One series of feeding experiments was completed in September, 1929, and another started in the succeeding April.

There being an insufficient surplus of brook-trout fingerlings to permit of a distribution in the fall of 1929, the plantings were confined to the liberation of larger fish. Among them were 450 tagged rainbow and steelhead trout from 1 to 3 pounds in weight. These were deposited in Vermont waters and reports on them have been coming in since the opening of the fishing season on the first of May. The liberations also included 675 brook-trout yearlings 6 inches in length and one hundred and sixty 2-year old brook trout averaging a pound or more in weight. The only fingerlings available for the fall distribution were two small lots of landlocked salmon and rainbow trout. The spawning of the station brood stock of brook trout began October 29 and additional eggs were taken to December 11, inclusive. For the first time since the station was operated it was unnecessary to secure eggs of this species from other sources. A sufficient number of eggs were taken to more than serve experimental needs and shipments both of eyed eggs and advanced fry or small fingerlings to a total of about 280,000 were transferred to other stations. In addition to the general spawning 55 pairs of selected brook trout were stripped and eggs kept in individual lots. The best record made by this stock was in the case of one lot that finished the fiscal year with a loss of only 9 per cent from the green-egg stage. Only the best of these lots will be retained for a future brood stock.

About the middle of December approximately 15,000 eggs were secured from a selected stock of rainbow trout reared from spawn produced at the White Sulphur Springs (W. Va.) station. Black-spotted trout, hatched from Yellowstone Park eggs in 1926, were stripped for the first time on April 15 and yielded eggs of exceptionally fine quality. Montana grayling, hatched in July, 1929, were successfully carried through the winter and by the close of the fiscal year some of them had attained a length of 6 inches. Experimental lots of rainbow trout and steelhead began spawning in April but their eggs were decidedly inferior to those secured from the black-spotted trout. In cooperation with the Vermont Department of Fish and Game, planting experiments involving both the grayling and the black-spotted trout will be instituted in the near future.

NASHUA (N. H.) STATION

[JAMES D. DEROCHER, Superintendent]

No important construction work was carried on during the year.

The station was supplied with brook-trout eggs from the collections of brood stock and by transfers from other stations, together with the purchase of eggs and fry from commercial hatcheries. A heavy loss was experienced with the brook trout from practically all lots during the fry stage. On July 1, 1929, 232,000 fingerlings were on hand, and all were distributed during the year with the exception of 5,000 retained as yearlings. At the opening of the year there were small lots of rainbow-trout and landlocked-salmon fingerlings, which were also distributed. Small collections of smallmouth bass fry and bullhead catfish were made from near-by waters for distribution. The total distribution of all species was in excess of 315,000, with 210,000 remaining on hand at the close of the year. In addition to the ordinary station work there were established five cooperative rearing plants with fish and game clubs, which were supplied with a total of 105,000 brook-trout fingerlings. While the distribution from these nurseries was not all that could be desired, it was considered satisfactory for the first year's work.

COMBINATION TROUT AND POND STATIONS

While five hatcheries have facilities for propagating both the trout and warm-water fish, in almost all cases the greatest production is attained with the former and the output of bass, sunfish, crappie, etc., is largely in the nature of a by-product derived from an additional utilization of the water supply after it has served its purpose for the propagation of trout. It is quite evident that the successful culture of pondfish must be carried on at a station specifically designed for that purpose, but in view of the overlap of the habitat of the cold water and warm water varieties, in many cases the dual capacities of these stations serve an admirable purpose.

ERWIN (TENN.) STATION

[A. G. KEESECKER, Superintendent]

A driveway was constructed from the hatchery to the new paved highway that passes through the station grounds. After grading the new road it was given a covering of railroad coal cinders. A new roof was installed on the office building, this job requiring an entire sheathing over the main building and the surrounding porches. The grounds were improved and protected by building a concrete and gravel walk from the spring to the foreman's cottage and constructing a fence along the new highway. The pond system was repaired by removing approximately 15,000 cubic feet of mud from the supply canal on the lower grounds and 1,000 cubic feet from five of the ponds. In making the fills necessary for the roadway 1,000 feet of earth were required. This was obtained by excavating a sufficiently large space in the bank for the building of a commodious storeroom or a garage. This space was lined with a concrete wall built on three sides, and it is expected to complete it at an early date.

Between November 25 and February 25 eggs to the number of 797,722 were taken from the station brood stock of rainbow trout. These eggs proved of inferior quality and did not produce a satisfactory output of fry. Four hundred thousand brook trout received by transfer were handled, and 50,000 of the same species were incubated for private parties. The output of fish of all species was somewhat smaller than that of the preceding year. The warm-water fishes were produced in about the usual numbers. The station cooperated with the Wytheville (Va.) station by furnishing it with fingerling rainbow trout. Supplies of tadpoles were also collected and forwarded for the work of the Chemical Warfare Service.

MANCHESTER (IOWA) STATION

[G. H. GILL, Superintendent]

In the course of the year the interior of the hatchery and the rearing room were given two coats of flat-tone paint throughout. Four of the other buildings were painted outside and two of them were reshingled. New wooden supports were installed for 64 metal troughs and the new Clark-Williamson trough. A cement water tank or cistern of 4,000-gallons capacity was constructed on a high point east of the hatchery. The old boiler was dismantled and a new 6-section low pressure steam boiler installed. Approximately 60 cubic yards of clay were hauled for the bottom of the new bass pond. One million eight hundred thousand rainbow-trout eggs of good quality were obtained from the station brood stock and handled in conjunction with 624,800 brook trout eggs received from outside sources. A fair rating was attained in the hatching and distribution of the product of these eggs and at the close of the year 50,000 rainbow and 130,000 brook trout fingerlings were on hand awaiting later shipment. All fingerling trout, both brook and rainbow, were entirely free from disease and made an excellent growth, but all of the brood trout, including yearling and 2-year-old stock, were seriously affected with gyrodactylus and considerable losses resulted. Unseasonably cold weather during the spring injured the eggs of the smallmouth black bass but there are indications that the output of rock bass will be good.

NEOSHO (MO.) STATION AND SUBSTATION

[W. H. THOMAS, Superintendent]

Having undergone a rather thorough restoration within the past two years, the stations in this field are all in good condition with the exception that the severe cold of the past winter caused the breaking of several of the pond walls. This damage will have to be repaired during the coming year. Notwithstanding the loss of approximately one-fourth of the brood stock of rainbow trout at the Bourbon substation in August, 1929, the results of the propagation work with this species during the year were somewhat in excess of those attained in any previous year. Although the parasite gyrodactylus manifested its presence among the stock of trout, no undue loss of fish was experienced. Approximately 3,500,000 eyed rainbow trout eggs were supplied to applicants, the shipments going east to New York, west to Montana, and also into South Dakota and North Carolina. The fingerling and adult rainbow-trout distribution amounted to 101,000. The combined weight of the latter aggregated 3 tons, and owing to their large size they could be delivered only for local streams. A very successful year was experienced in the propagation of the pondfishes. Fertilizer was used freely in the ponds and daphnia cultures introduced therein from time to time, greatly promoting the growth of the fish. The year's distribution of bass, crappie, bluegills, etc., was slightly more than 303,000 and exceeded the record of any previous year.

Bourbon (Mo.) substation.—The work at this station is conducted cooperatively with the owners of the property, and its main purpose is the production of rainbow-trout spawn. The fingerling fish resulting from the work are either retained for brood stock or given to the guests of the owners of the property. The rainbow-trout spawn collected during the year was of the highest quality, comparable in a measure to the eggs of wild trout, and all fingerlings carried were maintained throughout the season in excellent condition. The adult rainbows were fed on a ration consisting of two parts horse flesh, one part sheep liver, with a 30 per cent addition of middlings in the form of a mush. The collections of eggs at this substation have increased steadily in volume within the past few years and their quality during the past year was higher than has ever before been experienced here.

Langdon (Kans.) substation.—Owing to the severe drouth prevailing in this region the collection of pond fishes did not equal those of the preceding year, though they were larger than the take of any year before that one. The output included black bass, crappie, bluegills, etc., with black bass making up more than one-half the total.

WHITE SULPHUR SPRINGS (W. VA.) STATION

[EDWARD M. HAYNES, Superintendent]

While fewer trout eggs were handled than in the preceding year, the results of the work at this station are regarded as satisfactory. The total output of all species, including both fish and eggs, amounted to 3,380,826. Owing to a curtailment of the rainbow-trout work the station was not in a position to ship the usual number of eyed eggs. Notwithstanding this fact the output of fingerling rainbows was larger than heretofore and they were fish ranging from 2-inch fingerlings to the yearling size. At the beginning of the year 42,500 fingerling trout were on hand. Three hundred and fifteen thousand Loch Leven and 1,435,000 rainbow trout eggs were taken during the spawning season. To the eggs of the former were added 375,000 received from the Bozeman (Mont.) station and from the combined stock 463,200 fingerling Loch Levens of decidedly fine quality were produced and distributed. Distribution in the eyed stage absorbed 515,950 of the rainbow trout eggs. All the shipments were consigned to various points in the United States with the exception of one to South America. From the eggs of this species retained, 426,904 large fingerling fish were produced. The station received by exchange 2,510,000 brook trout eggs and developed from them 1,974,667 fine fingerling fish of which 15,000 were on hand at the end of the year.

Cooperative relations were maintained with the West Virginia Game and Fish Commission and the Virginia fisheries authorities. Such work for the State of West Virginia included the incubation of 1,200,000 brook trout eggs, and fingerling trout to the number of 110,300 were furnished for stocking nurseries established and operated by the State of Virginia.

Fish of the warm-water species were produced in about the usual numbers. The customary handicap of unfavorable weather was operative, and an abnormal loss of eggs occurred as the result of extreme temperature fluctuations during the spawning season. The output of fish of this class included 10,006 bream, 5,200 rock bass, and 12,700 black bass, all fingerlings. No new construction work was in progress during the year but everything was maintained in good repair.

WYTHEVILLE (VA.) STATION

[CHARLES B. GRATER, Superintendent]

While no construction work of a major nature was undertaken, the routine repairs and maintenance necessary for the upkeep of the plant were attended to by the station force. The entrance road was widened, and a cement retaining wall on the south side of the road was constructed for about three-quarters of its ultimate length. Collections of rainbow trout eggs from the station brood stock amounted to over 550,000, which was considerably below the quantity expected. This situation is ascribed to the fact that the eggs from which these fish were hatched, were obtained from Western stock and were not acclimated. The Craig Brook (Me.) station supplied 400,000 brook trout eggs but the lot suffered a fairly heavy loss in the fry and early fingerling stages. Under a plan inaugurated the previous year the State of Virginia operated three cooperative nurseries stocked with brook and rainbow trout fingerlings from this station. The distribution from the supply furnished the previous spring was unsatisfactory as heavy losses were experienced. These nurseries were stocked with above 180,000 rainbow and brook trout from Wytheville in the spring of 1930 and they were being fed at the close of the year. The station also cooperated with three private nurseries by supplying the fish.

The fall distribution of bass fingerlings of both the largemouth and smallmouth species was negligible owing to the severe cold weather during the spawning season the previous spring. A satisfactory distribution of rock bass and sunfish was obtained.

Further attention was given to the rearing of daphnia as a food for bass fry, and the utilization of these organisms was effective in producing bass fingerlings of a uniform size.

POND FISH STATIONS

The strictly pond fish hatcheries are located in the South and Southwest. The production of fish at a unit of this character is strictly dependent upon the water acreage, and every effort is being made to increase this water acreage while at the same time applying the methods of intensive fish culture to secure an augmented production of fish from the existing acreage. Owing to the fact that in most cases topographical conditions or a shortage of water supply definitely circumscribe the possibilities of expansion and make it necessary to establish substations, additional facilities must be created by the development of projects such as the Valdosta (Ga.) and Fort Worth (Tex.) auxiliaries.

COLD SPRING (GA.) STATION AND SUBSTATIONS

[CHARLES A. BULLOCK, Superintendent]

The dimensions of one large pond were increased about one-eighth, the shallow side of another was deepened to permit of a 1-foot lowering of the water level at overflow, and all new banks were seeded with grass. The swampy basin between Cold Spring and the highway was filled in to a depth of from 2 to 3 feet, and shade trees set out to form a small park. One-half the fish-culturist's cottage was reshingled. With the exception of three, which were used for the propagation of bluegill, bream, and speckled catfish, all station ponds were stocked during the spring with largemouth black bass. During April, May, and June all ponds were fertilized, at intervals of two weeks, with a mixture of superphosphate; but the results of such treatment did not appear to be beneficial. The output of the station ponds for the year consisted of 426,600 bass, 73,835 bream, and 3,825 catfish.

Harris Ponds (Ga.) substation.—These ponds were stocked with small brood bream in April, 1929. No artificial food was given the fish until July 1, after which they were fed daily until October on a mixture of fish meal and shorts. Shortly after the 1st of October the ponds were drawn down and all the fish transferred to the Cold Spring station. From this point the young ones, amounting to 50,000, were distributed.

Valdosta (Ga.) substation.—Development work was continued, and a second well, with a 16-inch casing was drilled. By means of the two wells Grassy Pond (between 200 and 300 acres in area) was drained by December. About 3,000 large bass were held in a pool of about 1½ acres for a future brood stock, with provision made for their escape when the pond refills to a point where it submerges the pool. All suitable bream were placed in Lot Pond (about 40 acres in area) as a future brood stock. Fifteen thousand bream fingerlings No. 2, 1,125 bass fingerlings No. 5, and 15,000 warmouth bass fingerlings No. 5 were given for the stocking of local waters, and about 2 tons of suckers and warmouth bass were carried away in sacks for use as food. Forty large alligators, some nearly 8 feet long, were shot in Grassy Pond during the year.

EDENTON (N. C.) STATION

[W. S. VINCENT, Superintendent]

Roach and fresh-water shrimp were introduced into the station ponds as a source of food supply, and the pond bottoms were fertilized. The negligible results attained with crappie having demonstrated the futility of further efforts with that species under present conditions, the pond formerly devoted to that work was used for bass culture. The production of bass fry exceeded all previous efforts by about 50 per cent and very favorable weather during the collecting period contributed to the good results. Auto trucks were again used to advantage in making the distributions. An attempt made to rear bass to fingerling size was not sufficiently productive to be considered a success. The poor results were probably due to a scarcity of protective aquatic vegetation. Among the more important of the minor improvements made during the year were the addition of a bathroom to the cottage occupied by the apprentice fish-culturist and the rebuilding of the woodshed attached to the superintendent's residence.

LOUISVILLE (KY.) STATION

[HERMAN O. HESEN, Superintendent]

Electric fixtures were installed in the cottages occupied by the superintendent and the fish-culturist; and repairs were made on station buildings, ponds, and grounds as needed. The L type of outlet was installed in six of the ponds, and much time and labor were expended in mending leaks in the ponds and the sewer lines. All work outlined above with the exception of installing the electric fixtures was performed by the station personnel. The output of 412,157 fry and fingerling smallmouth bass indicates a smaller output than in the previous year, but if the 1930 production of 143,750 largemouth bass fry and fingerlings is taken into consideration the combined total exceeds the 1929 output of both species by a substantial margin. The records show that in past years very small results have followed the attempts made to propagate largemouth bass. The past year's output of the species was produced in one pond less than three-fourths of an acre in area, and the yield is considered good. The Hesen bass trap was used in making the collections. It seems very evident that the Louisville station is well located for the work in which it is engaged, both the climatic and the water conditions being well suited to pond cultural operations.

The year's distributions also included 1,280 bream and 2,740 rock bass, all fingerlings, in addition to 1,500 rainbow trout. The rainbow trout were obtained from the White Sulphur Springs (W. Va.) station for a special plant in Kentucky waters.

Owing to limited pond acreage the rearing of fish to the fingerling stage is not practicable at this station. Such fingerlings as were produced the past year were fish that had escaped capture in the breeding ponds when the fry distribution was made. The provision of additional pond facilities would permit of a material increase in the output of fingerling fish from this field.

MAMMOTH SPRING (ARK.) STATION

[DELL BROWN, Superintendent]

The usual work of keeping the station grounds in good condition was performed by the station force. Concrete floors were put in the fuel house and the workshop of the office building. The ornamental fence was painted and 600 feet of new fencing was built. The 8-inch portion of the station water main was replaced with a 10-inch pipe and valve, and made possible a considerable addition to the water supply. Of a total of 52 nests of the smallmouth black bass observed in the spring, only 36 were productive. The season's output of this species amounted to 58,000 fry and 35,139 fingerling fish. The schools of young bass of the largemouth species were unusually good, and a total of 205,500 fingerlings and 4,000 fry of that species was distributed. There was also a satisfactory output of rock bass. In addition to the station fish-cultural work over 650,000 pond fishes, principally black bass, were produced at four cooperative units in whose work the station actively participated. The most important of these establishments was the Arkansas State hatchery at Lonoke.

ORANGEBURG (S. C.) STATION

[S. A. SCOTT, Superintendent]

A 2-story frame building, 27 by 60 feet in dimensions, was constructed. This building provides room for a garage, meat room, tool room, and workshop on the lower floor and the upper story is used for storage space. The two small buildings formerly used as a garage, stable, and tool house were torn down, and a foundation was completed for a new office building, which will include in addition sufficient room for sleeping quarters and storage space. The superintendent's residence was painted inside and outside and the porches screened. All brood ponds were thoroughly cleaned during the fall and winter, the mud and vegetation in them removed, and the ponds sanded and graded where necessary for proper drainage. Though interfered with to some extent by unfavorable weather, the general results of the year's fish-cultural efforts are regarded as satisfactory. Sudden temperature changes during the spawning season cut down the production of largemouth bass as compared with last year's figures. The 1930 output amounted to 323,455 fish of which approximately 200,000 were in the fingerling stage. The remainder were fry. Besides the bass work the distributions included 39,890 bluegill bream, 5,225 crappie, 4,860 warmouth bass, and 505 spotted catfish. In conjunction with the South Carolina Board of Fisheries two experimental shad hatcheries were constructed and operated in March and April, one of them being located on the Black River near Georgetown, S. C., and the other one 2 miles below Jacksonboro, S. C., on the Edisto River. At the former location 42,000 eggs were collected, while the collections on the Edisto numbered 560,000.

SAN MARCOS (TEX.) STATION AND SUBSTATIONS

[O. N. BALDWIN, Superintendent]

Construction operations during the year were confined to repair of present station buildings. The outbuilding attached to the superintendent's residence was repaired and painted, and repairs were made to the station office. The superintendent's residence, office building, and cottages were piped for gas. The main sewer line in the well-basin trench, which had become stopped with roots, was opened and relaid. The flag mound was removed and a pond constructed on the site. The excavated earth was used for leveling the grounds and for the construction of a levee. The year's distributions of fish from San Marcos station included 213,417 fingerling black bass and 82,111 fish of other species, among which were 5,860 Rio Grande perch. Black bass were supplied to 154 applicants—an average of 1,386 being delivered to each. In making the distributions the station messengers traveled 24,411 miles, made 59 trips, and carried 8 species of fish.

Lake Worth (Tex.) substation.—In addition to fish-cultural work, the activities at this point were confined to care of ponds and grounds. The total output of fish amounted to 299,420, including 7,925 fingerling black bass and 96,200 crappie. The latter were rescued from flood waters of the Trinity River and placed in permanent waters within a reasonable distance from the station.

New Braunfels (Tex.) substation.—The total output of fish amounted to 88,041. Of these 10,361 were black bass and the remainder were bream and warmouth bass.

Medina Lake (Tex.) substation.—Fish to the number of 11,507 were distributed from this auxiliary. This number included 7,347 black bass, 3,070 sunfish, and 1,120 rainbow trout. The substation was closed late in September.

TUPELO (MISS.) STATION AND SUBSTATION

[CHARLES R. WIANT, Superintendent]

The year's fish-cultural activities were marked by an appreciable increase in the production of bream and a falling off in the output of bass. The total distribution of the two species of bream handled at the station, amounted to 398,385 fingerlings and yearlings, while the production of fry and fingerling bass aggregated 402,450. In a water temperature of 60° F. the adult bass began nesting on February 27, fully a month earlier than in any previous year. On March 3 the station was visited by a cold wave, which quickly lowered the temperature of the water to 39° F. and caused all brood bass to abandon their nests. The loss of eggs in this instance was total. The occurrence of a second cold spell on March 26 reduced pond temperatures from 67° to 44° F. This resulted in some loss of eggs and partially arrested the development of the fish, as all schools thereafter collected were small and many of them contained two or three sizes of advanced fry. At the close of the fall distribution in 1929 a lot of 41,000 bream was carried over the winter and shipped during the spring in connection with the bass distributions. The object of this was to avoid a duplication of transportation expenses, as both the bream and part of the bass were destined to the same section of the country.

The year's activities included no important construction work, and the few minor repairs needed on station buildings were attended to by the regular personnel.

Aliceville (Ala.) substation.—The combined output of black bass and bream from the four ponds available amounted to 46,950, which, under the conditions existing is regarded as a very satisfactory year's work. Practically all of these were delivered at the ponds to applicants who called for them. Another pond approximately 2½ acres in area, supplied by a flowing well, has been acquired for the work in this field.

LAKELAND (MD.) PONDS

[E. K. Burnham, acting in charge]

During the spring of the calendar year 1929 the four principal ponds of this system were stocked with largemouth black bass, crappie, and bream and were used for the culture of the same species in the spring of 1930. Golden shiners were planted as forage fish. The production resulting from these plantings was distributed during the fall months as fingerlings, with the exception of a few which were carried through the winter and planted as yearlings in the spring of 1930. The 1930 hatches were trapped and distributed as advanced fry before the close of the fiscal year. The total distribution from these ponds during this period amounted to 193,800 of all species.

CENTRAL STATION AND AQUARIUM, WASHINGTON, D. C.

[Charles W. Burnham, Superintendent]

The usual exhibit of live fish and aquatic animals was maintained in the Central Station Aquarium throughout the year. Two thousand four hundred and twenty-six individual specimens, representing 34 species, were shown in addition to eggs of the chinook salmon, cisco, and pike perch, which were displayed throughout their incubation and fry periods. Fry to the number of 2,607,500 were produced from eggs thus incubated, while 380,737 fish were distributed to applicants and planted in public waters in the Eastern States. Nearly all of the latter number were hatched at the Lakeland (Md.) or the Fort Humphreys (Va.) substation.

Part 2.—DISTRIBUTION OF FISH AND FISH EGGS

[E. C. Fearnow, Superintendent of Distribution]

In view of the increased output of fingerling basses, trouts, and other inland fishes, the distribution problem was quite difficult, especially during the summer and fall months when the four cars were required to make shipments of fish from eight stations and substations. In addition to the 135 carload shipments of fish made during the year, detached messengers, traveling in baggage cars, made 1,235 trips direct from the stations, with each messenger carrying from 20 to 40 pails of fish.

The following table summarizes the distribution of fish and fish eggs during the fiscal year to applicants in the United States and its Territories. It also shows the plants of fish made by the bureau in public waters of the country in connection with the propagation of commercial fishes, and the salvage of fish from temporarily flooded lands.

Summary, by States, of the distribution of fish, fiscal year 1930

State and species	Number
Alabama:	
Catfish	1, 125
Largemouth black bass	359, 455
Sunfish	168, 445
Alaska:	
Humpback salmon	1, 389, 000
Sockeye salmon	11, 390, 000
Steelhead salmon	82, 000
Arizona:	
Largemouth black bass	1, 000
Loch Leven trout	100, 000
Sunfish	1, 200
Arkansas:	
Rainbow trout	16, 190
Crappie	1, 565
Largemouth black bass	246, 185
Rock bass	15, 400
Sunfish	710
California:	
Chinook salmon	12, 155, 000
Steelhead salmon	200, 000
Atlantic salmon	20, 000
Rainbow trout	100, 000
Loch Leven trout	50, 000
Colorado:	
Catfish	1, 200
Silver salmon	200, 000
Steelhead salmon	350, 000
Rainbow trout	1, 257, 500
Black-spotted trout	65, 800
Loch Leven trout	1, 327, 000
Lake trout	135, 000
Brook trout	4, 041, 300
Crappie	7, 500
Largemouth black bass	6, 800
Yellow perch	5, 425
Connecticut:	
Loch Leven trout	200, 000
Brook trout	17, 800
Largemouth black bass	150
Delaware:	
Brook trout	2, 000
Crappie	300
Largemouth black bass	1, 111
Sunfish	300
District of Columbia:	
Largemouth black bass	100
Crappie	500
Sunfish	500
Florida:	
Largemouth black bass	5, 150
Sunfish	600
Georgia:	
Catfish	2, 575
Rainbow trout	685, 950
Largemouth black bass	203, 575
Warmouth bass	16, 400
Sunfish	97, 435
Idaho:	
Chinook salmon	3, 019, 000
Steelhead salmon	300, 000
Rainbow trout	713, 700
Golden trout	8, 000
Brook trout	8, 260
Smelt	12, 000, 000
Illinois:	
Catfish	3, 880, 000
Buffalofish	172, 000
Carp	279, 025
Black-spotted trout	13, 200
Loch Leven trout	15, 000
Pike and pickerel	820
Crappie	3, 927, 275
Largemouth black bass	11, 040
Sunfish	454, 9[illegible]0
Yellow perch	750
Miscellaneous	717, 100
Indiana:	
Catfish	1, 135
Rainbow trout	32, 400
Brook trout	54, 000
Crappie	3, 750
Indiana—Continued.	
Largemouth black bass	3, 515
Smallmouth black bass	192, 300
Sunfish	10, 730
Yellow perch	575
Iowa:	
Catfish	55, 000, 000
Buffalofish	78, 150, 000
Carp	79, 000, 000
Rainbow trout	15, 100
Brook trout	1, 600
Pike and pickerel	175, 450
Crappie	2, 434, 350
Largemouth black bass	119, 275
Sunfish	9, 100, 000
Pike perch	112
Yellow perch	175, 637
White bass	140, 930
Fresh-water drum	980
Miscellaneous	2, 800, 000
Kansas:	
Catfish	4, 825
Crappie	1, 750
Largemouth black bass	3, 140
Sunfish	925
Kentucky:	
Largemouth black bass	143, 595
Smallmouth black bass	138, 409
Rock bass	6, 640
Sunfish	1, 280
Louisiana:	
Largemouth black bass	160
Rock bass	2, 400
Sunfish	400
Maine:	
Landlocked salmon	821, 830
Atlantic salmon	821, 400
Brook trout	1, 367, 302
Crappie	400
Largemouth black bass	1, 125
Cod	1, 179, 159, 000
Haddock	124, 920, 000
Winter flounder	2, 434, 538, 000
Maryland:	
Shad	446, 000
Chinook salmon	7, 500
Rainbow trout	210, 100
Loch Leven trout	202, 400
Brook trout	96, 850
Crappie	400
Largemouth black bass	7, 639
Smallmouth black bass	1, 250
Sunfish	7, 840
Massachusetts:	
Catfish	421
Landlocked salmon	5, 000
Rainbow trout	82, 608
Loch Leven trout	100, 000
Lake trout	3, 000
Brook trout	150, 135
Pike and pickerel	400
Mackerel	16, 502, 000
Sunfish	25
Yellow perch	1, 500, 360
Cod	1, 105, 644, 000
Haddock	131, 840, 000
Pollock	616, 693, 000
Winter flounder	902, 051, 000
Michigan:	
Whitefish	88, 500, 000
Cisco	100, 000
Steelhead salmon	50, 000
Landlocked salmon	10, 000
Rainbow trout	179, 700
Lake trout	29, 461, 000
Brook trout	729, 500
Crappie	3, 975
Largemouth black bass	19, 300
Smallmouth black bass	6, 200
Sunfish	9, 090
Pike perch	6, 690, 000
Yellow perch	2, 770

Summary, by States, of the distribution of fish, fiscal year 1930—Continued

State and species	Number
Minnesota:	
Catfish	4,614,841
Buffalofish [1]	75
Carp [1]	17,208
Whitefish	195,000
Rainbow trout	131,000
Loch Leven trout	151,500
Lake trout	91,000
Brook trout	258,500
Pike and pickerel	38,888
Crappie	3,453,665
Largemouth black bass	38,102
Sunfish	7,703,286
Pike perch	5,875,000
Yellow perch	1,905,825
White bass	3,210
Miscellaneous	5,693,208
Mississippi:	
Catfish	1,168,668
Buffalofish	29,000
Carp	693,100
Pike and pickerel	5,522
Crappie	3,884,712
Largemouth black bass	571,344
White bass	4,291
Fresh-water drum	372
Missouri:	
Rainbow trout	733,393
Crappie	2,425
Largemouth black bass	73,227
Rock bass	16,561
Sunfish	7,666
Montana:	
Rainbow trout	3,319,050
Golden trout	46,800
Black-spotted trout	2,969,350
Loch Leven trout	7,702,000
Brook trout	214,200
Grayling	1,100,000
Crappie	60,850
Largemouth black bass	57,202
Sunfish	11,675
Yellow perch	100
Nebraska:	
Rainbow trout	54,000
Loch Leven trout	47,000
Brook trout	72,000
Crappie	7,200
Largemouth black bass	1,400
Sunfish	146,550
Yellow perch	900
Nevada:	
Rainbow trout	901,500
Loch Leven trout	150,000
Brook trout	20,000
New Hampshire:	
Catfish	36
Chinook salmon	75,000
Steelhead salmon	7,000
Landlocked salmon	12,938
Rainbow trout	3,390
Brook trout	1,233,390
Largemouth black bass	3,225
Smallmouth black bass	13,100
Pike perch	500,000
Yellow perch	4,900,000
New Jersey:	
Catfish	400
Rainbow trout	1,500
Brook trout	10,000
Largemouth black bass	12,774
Sunfish	2,120
Yellow perch	128
New Mexico:	
Catfish	3,200
Steelhead salmon	137,500
Rainbow trout	12,000
Loch Leven trout	2,504,000
Brook trout	143,500
Largemouth black bass	9,890
Rock bass	7,250
Yellow perch	300
New York:	
Catfish	23,300
Whitefish	580,000
Cisco	27,850,000
Landlocked salmon	120,000
Rainbow trout	58,120
Black-spotted trout	10,000
Loch Leven trout	72,600
Lake trout	1,408,000
Brook trout	922,925
Crappie	2,200
Largemouth black bass	25,458
Smallmouth black bass	1,980
Sunfish	23,485
Pike perch	2,200,000
Yellow perch	5,800,000
North Carolina:	
Catfish	1,000
Shad	2,350,000
Glut herring	10,000,000
Rainbow trout	240,300
Loch Leven trout	150,000
Brook trout	126,900
Crappie	1,650
Largemouth black bass	320,075
Rock bass	300
Warmouth bass	235
Sunfish	45,820
Yellow perch	2,150,000
North Dakota:	
Catfish	1,000
Rainbow trout	2,000
Largemouth black bass	8,140
Sunfish	760
Yellow perch	2,900
Ohio:	
Catfish	2,675
Carp	2,600,000
Whitefish	62,940,000
Steelhead salmon	30,000
Rainbow trout	9,600
Brook trout	70,100
Largemouth black bass	8,850
Sunfish	2,386
Pike perch	108,000,000
Yellow perch	1,125,625
Oklahoma:	
Catfish	5,930
Rainbow trout	4,547
Crappie	9,060
Largemouth black bass	35,933
Rock bass	1,515
Sunfish	110
Oregon:	
Chinook salmon	2,095,000
Sockeye salmon	56,500
Silver salmon	373,800
Chum salmon	35,000
Steelhead salmon	3,425,660
Rainbow trout	157,250
Loch Leven trout	225,250
Pennsylvania:	
Catfish	17,640
Common sucker	6,750,000
Atlantic salmon	20,000
Rainbow trout	603,000
Loch Leven trout	296,300
Brook trout	2,031,000
Crappie	5,711
Largemouth black bass	29,865
Smallmouth black bass	50
Sunfish	25,990
Pike perch	25,585,000
Yellow perch	2,520
Rhode Island: Brook trout	20,000
South Carolina:	
Rainbow trout	41,500
Brook trout	40,500
Crappie	5,075
Largemouth black bass	253,305
Rock bass	2,175
Warmouth bass	3,560
Sunfish	37,915

[1] Rescued fish planted in the Mississippi River.

Summary, by States, of the distribution of fish, fiscal year 1930—Continued

State and species	Number	State and species	Number
South Dakota:		Washington:	
Rainbow trout	153, 350	Chinook salmon	6, 485, 750
Loch Leven trout	297, 900	Chum salmon	24, 409, 000
Brook trout	746, 764	Silver salmon	6, 232, 700
Crappie	26, 200	Sockeye salmon	15, 165, 190
Largemouth black bass	13, 500	Humpback salmon	3, 323, 300
Yellow perch	4, 800	Steelhead salmon	2, 967, 260
Tennessee:		Rainbow trout	90, 000
Rainbow trout	130, 650	Black-spotted trout	2, 422, 000
Brook trout	9, 150	Brook trout	257, 700
Largemouth black bass	72, 545	West Virginia:	
Smallmouth black bass	824	Catfish	10, 450
Rock bass	22, 455	Rainbow trout	204, 870
Sunfish	18, 205	Loch Leven trout	136, 310
Texas:		Brook trout	773, 660
Rainbow trout	1, 120	Crappie	1, 430
Crappie	98, 925	Largemouth black bass	30, 085
Largemouth black bass	224, 784	Smallmouth black bass	81, 150
Rock bass	1, 850	Sunfish	20, 455
Warmouth bass	10, 505	Yellow perch	180, 465
Sunfish	382, 605	Pike perch	800, 000
Rio Grande perch	5, 846	Wisconsin:	
Utah:		Catfish	32, 914, 325
Silver salmon	526, 176	Buffalofish	55, 980
Rainbow trout	2, 126, 000	Carp	622, 665
Loch Leven trout	270, 000	Cisco	6, 000, 000
Brook trout	499, 000	Rainbow trout	76, 650
Vermont:		Brook trout	1, 006, 300
Steelhead salmon	11, 600	Pike and pickerel	229, 915
Landlocked salmon	45, 000	Crappie	9, 068, 285
Rainbow trout	700	Largemouth black bass	75, 805
Lake trout	90, 000	Sunfish	8, 495, 310
Brook trout	1, 165, 118	Pike perch	1, 650, 000
Largemouth black bass	270	Yellow perch	540, 955
Smallmouth black bass	11, 500	White bass	137, 111
Pike perch	15, 000, 000	Fresh-water drum	1, 005
Yellow perch	74, 800, 540	Miscellaneous	9, 719, 800
Virginia:		Wyoming:	
Catfish	2, 000	Catfish	150
Shad	1, 800, 000	Black-spotted trout	10, 477, 000
Rainbow trout	278, 549	Loch Leven trout	2, 454, 240
Loch Leven trout	8, 500	Brook trout	910, 395
Brook trout	298, 200	Crappie	41, 300
Largemouth black bass	155, 737	Largemouth black bass	10, 400
Smallmouth black bass	575	Sunfish	9, 000
Crappie	5, 300	Yellow perch	4, 500
Rock bass	25, 450		
Sunfish	54, 850		
Yellow perch	80, 150, 000		

METHOD OF DISTRIBUTION

In making the distribution of fish it is the policy of the bureau to supply first the water from which the eggs are collected, after which shipments are made to suitable public and private waters on applications previously submitted. Blanks on which formal applications may be made will be furnished to applicants on request. Such blanks call for a complete description of the waters to be stocked and from the information furnished, the bureau assigns the species that are suitable.

Applicants are notified immediately as to the species that will be sent them and the approximate date of delivery and they are given instructions for receiving and caring for the fish. Before shipment is made a second notice is given, usually by telegram, stating the exact time of arrival of the fish at the railroad station. The fish are delivered at the applicant's railroad station free of charge and in the event that the shipment is delayed the applicant is notified accordingly.

Applicants are expected to provide suitable receptacles for carrying fish, such receptacles to be in readiness at the railroad station specified in the advance notice of delivery. The vessels should be uncovered and empty.

In making allotments of fish on applications the following items are taken into consideration: The area of water to be stocked, size and number of fish available for distribution, and the distance the fish must be transported. The bureau distributes fish as fingerlings or yearlings. At some stations, however, it is necessary to distribute a portion of the output as fry in order to prevent overcrowding.

The basses, sunfishes, and other pond fishes are distributed from three weeks to several months after they are hatched. The basses usually range from 2 to 6 inches in length, and the sunfishes from 2 to 4 inches in length. Commercial fishes, such as whitefish, yellow perch, etc., are produced in large numbers and are necessarily planted as fry. As a general rule the bureau delivers fish in the order in which the applications are received, and applications remain on file until delivery of the desired fish can be made.

Shipments of trout from the bureau's eastern stations are usually made during May and June, and applications received after April 1 will be carried on file for attention during the following year. The distribution of trout from stations in the Rocky Mountain region is made from May to October, and applications from that section should be submitted prior to May 1 in order to assure early delivery. Requests for bass, sunfish, and crappie should be on file with the bureau prior to May 1, as deliveries of such species are made between May and December.

During the year the bureau's cars traveled 115,497 miles of which 13,858 were free. Detached messengers traveled 390,356 miles of which 78,243 were free.

NEW DISTRIBUTION CAR

Near the close of the distribution in the fall of 1929 it was necessary to take out of commission car No. 3, for the reason that the car was very old, and, being of wood construction, was unsafe in modern steel trains. The condition of this car was forcibly brought to the attention of the bureau in a telegram from the Chicago, Milwaukee, St. Paul & Pacific Railroad Co. under date of October 16, 1929, as follows: "In interest of safety we can not undertake to handle U. S. fish car three account wooden construction, New Lisbon to Wausau tomorrow morning on train one naught three." The car at best could be used only on short trips, so it was brought to Washington and placed on a siding at Union Station.

While the bureau's new distribution car No. 10 has been completed and placed in commission, the service is still short one car. Car No. 10 takes the place of car No. 4, which was disposed of several years ago.

The distribution work is becoming heavier every year due to the increased output of fish, especially of the larger sizes. Years ago, when the bureau's output did not exceed 3,000,000,000 fish, it maintained 6 distribution cars. Only 4 cars are now available to handle an output of over 7,000,000,000 fish.

TROUT DISTRIBUTION

The distribution problem as pertains to trout is becoming more difficult each year, owing to the general tendency to produce large-sized fish.

When the distribution of trout is made during March or early in April it is possible to carry 1,000 to 1,500 small fish per can, while if the same fish were left at the station until September or October not more than 100 could be carried in a can. With its present facilities the bureau would not be able to handle the distribution of trout from its stations were it not for the assistance of a number of substations and cooperative plants. The fish are relayed to these plants at a time when they can be carried 1,000 or more to the can. In this way the distribution problem is minimized and the bureau is able to accomplish considerable more work than would be possible by making all distributions direct from its stations. One car of fry delivered to cooperative plants in the spring, under favorable conditions, will grow into 8 or 10 carloads of fingerling fish by the 1st of October. From the foregoing it will be seen that the intelligent assignment of fish to substations and cooperative projects enables the bureau to perform eight or ten times more work than would be possible if such facilities were not available.

The distribution from cooperative projects is simplified by the fact that their location is in proximity to the streams that are to be stocked enabling shipments to be handled by trucks at a nominal cost. Moreover, the sportsmen often proffer their services and automobiles for making plants of fish from cooperative projects sponsored by their organizations.

In order to properly supply the various cooperative projects throughout the country it is necessary to remove during the months of April, May, and June approximately 30 carloads of small trout. This work is, of course, in addition to the general distributions which the bureau conducts from its stations to applicants who have not the facilities for rearing fish in troughs but plant them direct in suitable waters. The generally increasing demand for fish from 3 to 6 inches in length—large enough to take care of themselves in open waters—is reflected in the output of practically every hatchery of the bureau.

The Bozeman (Mont.) station formerly distributed its output as fry and small fingerlings, but last year it reared brook trout until they were 3 and 4 inches in length. To make a proper distribution of these fish, a car was required in the State of Montana from July 1 until along in November.

The Craig Brook (Me.) station last year, in addition to its general distribution made during the months of May and June, reserved several hundred thousand fish, consisting of brook trout and land-locked salmon. The distribution during the fall months was handled by special messengers with the assistance of one of the distribution cars at a time when the services of the car were urgently needed in connection with the general distribution from the rescue stations along the Mississippi River.

Another plant that within recent years has been producing large numbers of trout is the bureau's semicooperative project in connection with the Jefferson County Rod and Gun Club of Watertown, N. Y. The bureau's station at Cape Vincent, N. Y., is equipped for incubating large numbers of trout, but does not have the facilities for rearing them until they are 3 or 4 inches in length. Large numbers of these trout are transferred early in the year to the Watertown nursery and reared until the 1st of October. Were the distribution made direct from the Cape Vincent station early in the spring, there would not be more than 300 cans of fish, but when reared until fall at Watertown there are several thousand cans.

The same tendency to produce large-sized fish exists at the Nashua, Hartsville, Neosho, and Leadville stations.

COOPERATION WITH THE UNITED STATES FOREST SERVICE

Of all the work accomplished by the bureau in the stocking of inland waters, none is of more importance than that which pertains to keeping up the supply of game fishes in the national parks and forest preserves. These great recreation grounds are visited annually by millions of tourists, a majority of whom are interested in fishing. The problem of maintaining a supply of fish in park waters is becoming, therefore, more acute with the increased popularity of angling. The efforts being made to keep up the supply of fish in forest preserves are set forth in the report of R. Y. Stuart, Forester, which follows:

The following summary on fish distribution presents the data by States and regions for the season of 1929. The data for the season of 1930 were inadequate to afford detailed information at this time, but it is understood that at least the number of fish indicated in the total, or over 37,000,000 exclusive of region 6, will be required for the next year.

Region	State	Planted 1929
1	Idaho	15,263,000
	Montana	767,500
	Washington	390,000
	Total	16,420,500
2	Colorado	3,532,500
	Nebraska	1,500
	South Dakota	159,000
	Wyoming	1,635,200
	Total	5,328,200
3	Arizona	1,509,034
	New Mexico	1,358,415
	Total	2,867,449
4	Idaho	3,355,313
	Nevada	493,750
	Utah	4,391,175
	Wyoming	661,480
	Total	8,901,718
5	California	2,865,409
7	Alabama	21,000
	Arkansas	23,250
	New Hampshire	256,750
	North Carolina	243,500
	Tennessee	43,037
	Virginia	43,500
	West Virginia	89,300
	Total	720,337
	Grand total	37,103,613

Forester Stuart summarizes conditions in the national forests, as follows:

(1) As a general rule national forest streams are declining in numbers of fish. Potentially they are capable of meeting the demand of ever-increasing recreational use.

(2) The main causes for the reductions in fish are: (*a*) Increased demands due to the increased travel in the national forests, and (*b*) the number of fish planted is wholly inadequate in consideration of the losses which occur in planting.

(3) There is a lack of coordination of effort and cooperation among different agencies interested in restocking streams.

(4) There is inadequate basic information on the adaptability of streams to different species and the capacity of such streams.

FIGURE 4.—Planting trout in national park waters

(5) There is too much loss in transplants due to size of fish turned into streams, the lack of proper handling facilities, inadequate arrangements among cooperative agencies, and inexperience in the technique of transplanting by some of those entrusted with the care of fish.

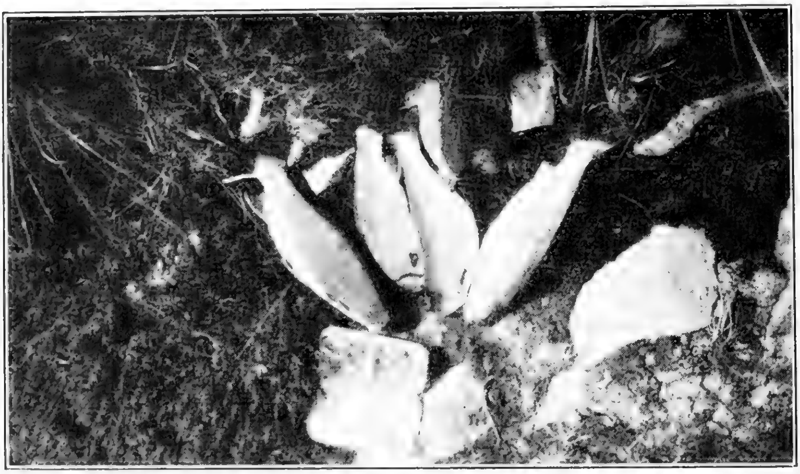

FIGURE 5.—Landlocked salmon and eastern brook trout from national forest waters. These fish were planted in 1921 and caught in 1923

(6) Losses from irrigation ditches are enormous, and while some progress has been made in the development and installation of screens there is inadequate supervision and attention given to this phase of the question.

(7) Little is known of the losses due to predators in the form of either fish or animals and birds, or the proper balance that might be maintained between our fur bearers, bird life, and fish.

(8) The laws of the various States lack uniformity and scientific basis of regulation of catch.

(9) Adequate control of forest cover through the prevention of fires or its destruction by other means is not sufficiently appreciated.

DISTRIBUTION CARS

CAR NO. 3

[E. K. BURNHAM, Captain]

Early in July, 1929, messengers were engaged in the distribution of trout from La Crosse, Wis., to cooperative nurseries and continued making isolated trips from various stations until after the middle of November. Being of wooden construction, the car could be moved in local trains only. The fish moved by messenger trips direct from stations in regular distributions are as follows:

Species	Fingerlings					Yearlings	Adults
	No. 1	No. 2	No. 3	No. 4	No. 5		
Catfish			75	1,650			
Rainbow trout		14,500					
Crappie		1,100	5,900			985	425
Largemouth black bass		3,750	9,465	1,665	1,255	1,560	30
Sunfish	36,350	16,400	750	2,885		2,089	
Yellow perch			4,900	1,750			
Total	36,350	35,750	21,090	7,950	1,255	4,634	455

The car traveled 10,028 miles and made 14 trips. The first carload was trout taken from the Manchester (Iowa) station on July 9 and the first carload of spiny-rayed fishes was taken on at La Crosse, Wis., August 22.

The following table shows the number, size, and species of fish moved by the car direct from stations during the fiscal year:

Species	Fingerlings					Yearlings	Adults
	No. 1	No. 2	No. 3	No. 4	No. 5		
Catfish		3,000	4,075	3,000	510		108
Buffalofish							8
Rainbow trout	31,500	2,000					
Black-spotted trout							9
Grayling							18
Pike and pickerel							12
Crappie	1,500	2,250	12,845	480		450	139
Largemouth black bass		5,400	35,710	11,990	3,645		136
Smallmouth black bass			1,100				
Rock bass							30
Strawberry bass							30
Sunfish	22,500	2,000	3,285	12,150			192
Yellow perch		1,200	10,350	150	1,130		
Total	55,500	15,850	67,365	27,770	5,285	450	682

Car No. 3 arrived at Washington, D. C., November 21, 1930, and was taken out of commission on account of its unsafe condition.

CAR NO. 7

[E. R. WIDMYER, Captain]

The distribution of brook and rainbow trouts was carried on from the Manchester (Iowa) station during the early part of the fiscal year, the car making a trip from Manchester to Eau Claire, Wis., delivering 60,600 2-inch brook trout and 24,700 1-inch rainbow trout to Wisconsin applicants.

The distribution of warm-water species was begun from the river stations on August 21, when the car made a trip from La Crosse, Wis., to Des Moines, Iowa, taking fish from Homer, La Crosse, Marquette, and Bellevue stations. On completion of the Des Moines trip the car returned to Marquette and made a trip from Marquette, Iowa, to Duluth, Minn. After completing the Duluth trip the car returned to La Crosse and made a trip from that point to Bay City, Mich. From Bay City the car returned to Marquette, Iowa, where a load of fish was obtained for Columbus, Ohio. On completion of the Columbus trip the car returned to La Crosse where it received a load of fish for Madison, Wis. From Madison the car proceeded to Bellevue, Iowa, where it obtained a load of fish for waters in the vicinity of Pittsburgh, Pa., and on completion of this trip it was ordered to Fairport, Iowa. After making the Syracuse, N. Y., Albany, N. Y., and Cumberland, Md., trips from Fairport the car returned to Bellevue, Iowa, where it obtained a load of bass, bream, etc., for waters in the vicinity of Clarksburg, W. Va. From Clarksburg the car returned to Bellevue and was loaded with 249 pails of river fishes for waters at Cambridge Springs, Pa., returning to La Crosse on completion of the trip.

From August 21 to November 11, car No. 7 made 12 long eastern trips from the rescue stations, carrying from 249 to 252 pails and making as many as 9 messenger shipments on a single car trip. On the car's arrival at La Crosse from Cambridge Springs it was directed to proceed to Lynxville, Wis., from which station it made 2 trips to Miles City, Mont., and 1 trip to Trempealeau, Wis., with brood stock. The distribution from the rescue stations closed November 27 at which time the car was returned to La Crosse and placed on steam tracks of the Milwaukee road where it was held until January 8.

The car was placed in the Milwaukee shops at Milwaukee, Wis., on January 9 for annual repairs. The repair items of most importance were the refinishing of the car's interior, painting of exterior, removal of electric wiring from the interior ceiling to outside top of car, the removal of wall-board ceiling and the replacing of same with white wood veneer, and the simplifying of the air line to prevent the sticking of the brakes. While the car was in the shops the crew was left at La Crosse to renew the aerating equipment of the car and to give the transportation pails a complete overhauling and thorough cleaning.

The car left the shops on February 27 and arrived at La Crosse on February 28. The equipment of the car was replaced and a trip made with 200,000 brook trout and 50,000 rainbow trout from La Crosse to the Lynxville holding station. A messenger shipment of 100 adult bream was made from La Crosse to Crawford, Nebr., on April 19, for brood stock at the Crawford station.

The car left La Crosse on April 28 with a load of trout for Wisconsin applicants. After the trip was completed the car proceeded to Duluth, Minn., and took up the distribution of lake trout, lake herring, whitefish, pike perch, and brook trout from the Duluth station.

After making 6 car trips, 3 boat trips, and a number of messenger shipments from the Duluth station, the car proceeded to Manchester, Iowa, and made 1 trip to Waupaca and 1 trip to Milwaukee, Wis., completing this work and returning to La Crosse on July 26.

During the fiscal year 1930 car No. 7 made 27 trips, traveled 26,232 miles, and delivered 24,095,787 fish. Messengers made 94 trips and traveled approximately 48,000 miles. The following table shows the number, size, and species of fish delivered by car and crew:

Species	Fry	Finger-lings Nos. 1 to 6	Year-lings	Adults
Catfish		49,420	1,740	100
Lake Herring	6,100,000			
Whitefish	3,195,000			
Rainbow trout		103,652		
Loch Leven trout		26,650		
Lake trout	6,391,000	45,000		
Brook trout		457,100		
Crappie		10,280	2,435	1,532
Largemouth black bass		74,440	40	2,074
Smallmouth black bass		5,980		
Sunfish		58,105	8,370	3,369
Pike perch	7,540,000			
Yellow perch		13,395	945	160
Total	20,226,000	844,022	13,530	7,235

CAR NO. 8

[T. H. COPELAND, Acting Captain]

At the beginning of the fiscal year car No. 8 was engaged in moving a carload of adult yellow perch from Seneca, Nebr., to Strang, Okla., and on completion of this trip proceeded to Malta, Colo., where the distribution of trout from the Leadville station was begun. During this distribution, car No. 8 made 7 trips from Malta to points in Colorado and moved 1,470 pails of fish, or 1,809,000 brook, rainbow, and black-spotted trout. Messengers on detached trips moved 426,000 brook, 10,000 black-spotted, and 95,000 rainbow trout. The car completed the Leadville distribution of August 30, and moved to Bellevue, Iowa.

The car loaded at Bellevue on September 6 with 210 pails of miscellaneous river fishes for points in Massachusetts, Connecticut, and Maine. On completion of this trip the car continued on to Bucksport, Me., and made trips from that point to Dover-Foxcroft, and Grindstone, Me., moving 420 pails of fish which completed the Maine distribution.

Car No. 8 returned to Marquette, Iowa, and loaded on August 19 with 210 pails of miscellaneous river fishes for applicants in northern Michigan, returning to Marquette, where another load of fish was obtained for delivery in Missouri. On completion of this trip the car returned to Neosho, Mo., where 2 carloads of fish were moved to nursery ponds. After completing the Neosho distribution, the car proceeded to Langdon, Kans., where 5 car trips were made from the Langdon station to points in Oklahoma, Kansas, New Mexico, and Tennessee. During this distribution 1,133 pails of black bass, bream, crappie, rock bass, catfish, and yellow perch were distributed in various streams in the above-mentioned States.

On November 9 the car moved 210 pails of pond fishes from the Langdon station to points in New Jersey and Pennsylvania, returning to Marquette, Iowa, where a load of miscellaneous river fishes was obtained and distributed in Pennsylvania. The car arrived at Washington, D. C., on November 25, and the crew was detailed to the various stations for winter work.

On January 15 car No. 8 was placed in the Pennsylvania railway shops at Wilmington, Del., for annual repairs. The work was completed on February 20 and the car returned to Washington, D. C.

The car left Washington April 4 for White Sulphur, W. Va., where 150,000 trout were obtained and distributed to cooperative nursery ponds in the vicinity of Scranton, Pa. On completion of this trip the car returned to Fishery, Tenn., to take up the trout distribution from the Erwin (Tenn.) station. During the Erwin work the car moved 4 carloads of fish to points in North Carolina, South Carolina, Georgia, and Virginia.

Upon completing of the Erwin distribution on April 30, the car moved to Wytheville, Va., and obtained 40,255 rainbow trout for applicants at Hazleton and Scranton, Pa. The car proceeded from Hazleton, Pa., to Great Barrington, Mass., where 84,000 brook trout were received and delivered to applicants in Pennsylvania, returning to White Sulphur, W. Va. The car moved 3 loads of fish from the White Sulphur station to points in Virginia, West Virginia, Pennsylvania, and Ohio, and then proceeded to La Crosse, Wis. At the close of the fiscal year the car was completing the Manchester, Iowa, distribution.

During the year the car traveled 32,819 miles, made 36 trips over 31 roads, and delivered fish in 27 States. Detached messengers made 124 trips, traveling approximately 40,000 miles away from the car. The following tabulation will show the number, size, and species of fish delivered by car No. 8 and messengers operating from the car.

Species	Fry	Fingerlings				Yearlings and adults
		No. 1	No. 2	No. 3	No. 4	
Catfish			9,400	9,150	2,300	2,580
Atlantic salmon				90,400		
Landlocked salmon					3,500	
Rainbow trout		535,600	329,900	68,600	20,100	1,155
Black-spotted trout		46,000		21,000		
Loch Leven trout		131,000	34,600			
Brook trout		2,380,000	491,950	159,650	2,000	
Crappie			2,875	9,810	900	75
Largemouth black bass	119,000		15,175	73,960	9,875	6,593
Rock bass			5,000		375	
Bream		2,800	35,210	8,075	3,380	1,560
Yellow perch				3,000	970	2,000
Total	119,000	3,095,400	924,110	443,645	43,400	13,963

CAR NO. 9

[F. W. A. ENGLEHARDT, Captain]

At the beginning of the fiscal year, car No. 9 was engaged in the distribution of trout from the Bozeman (Mont.) station. Twenty-two trips were made to points in Montana, Idaho, Washington, and Wyoming. Early in September the car proceeded to Miles City, Mont., to take up the distribution of black bass and other warm-water fishes. Shipments were made to points in Montana, Wyoming, and South Dakota. In November the car returned to Bozeman to receive fingerling trout for distribution en route east and adult specimens for the Washington, D. C.; Lincoln Park, Chicago, Ill.; and La Crosse, Wis., aquariums and the Milwaukee, Wis., museum.

A trip with river fish was made from Marquette, Iowa, to points in Indiana, Ohio, and Michigan, the car returning via Chicago to Bloomington, Ill., in December to be placed in the Chicago & Alton railroad shops for annual repairs. New tubes were installed in the boiler and general repairs made to the car and running gear. Early in March instructions were received to proceed to Charlevoix, Mich., and begin the distribution of lake trout and whitefish and upon completion of this work the car proceeded to Northville, Mich., and took up the distribution from that station. Early in May the car proceeded to La Crosse, Wis., where it made a number of shipments returning to Bozeman, Mont., in June making 4 carload plants from the Bozeman station before the close of the fiscal year.

During the fiscal year car No. 9 made 50 trips traveling 34,932 miles and delivering 12,762 pails of fish to 949 applicants. The following table shows the species, number, and size of fish delivered:

Species	Fry	Fingerlings						Yearlings and adults
		No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	
Catfish				3,400				100
Whitefish	19,600,000							
Rainbow trout		476,500	327,600	106,460	129,850			4
Black-spotted trout		956,600	22,000					35
Loch Leven trout			252,390	14,400	7,500			18
Lake trout	2,600,700							
Brook trout		683,000	626,000	132,675	391,170	1,500	3,750	5
Golden trout		8,000						200
Grayling								74
Crappie			146,350	1,600				280
Largemouth black bass				103,850	3,750			
Bream		11,000			25			6,510
Yellow perch				450	13,975	400		120
Total	22,200,700	2,135,100	1,374,340	362,835	546,270	1,900	3,750	7,346

CAR NO. 10

[E. M. LAMON, Captain]

This car was built by the Bethlehem Steel Co. at their Harlan plant, Wilmington, Del., during the fiscal year and was completed on December 28. The car arrived at Washington on January 2 where part of the crew was assembled and the work of placing loose equipment aboard and fitting the car out for transporting fish was taken up. After completing this work the car was ordered to White Sulphur Springs, W. Va., arriving at that point on March 17.

On March 18, 483,400 fingerling trout were obtained from the White Sulphur Springs station and transported to Keyser, W. Va., for stocking a nursery near Petersburg, W. Va. After completing this trip the car returned to Washington, D. C.

Messenger shipments were forwarded from Washington, D. C., during the latter part of March to Moorestown, N. J.; Cresco, Pa.; Richmond, Va.; and Martinsburg, W. Va., delivering 180,000 yellow perch fry, 800 yearling yellow perch, and 75 adult brook trout to applicants at these points.

The car was ordered to proceed to White Sulphur Springs, W. Va., on April 6 to take up the distribution from that station. Trips to Williamsport, Altoona, Connellsville, and Latrobe, Pa., were made during April, delivering 535,000 fingerling brook trout, 155,400 fingerling rainbow trout, and 103,800 fingerling Loch Leven trout to cooperative nurseries and applicants in Maryland and Pennsylvania.

After completing the trip to Latrobe, Pa., the car proceeded to Cumberland, Md., where the crew assisted in seining the ponds at Lakewood hatchery near Cumberland. These ponds yielded 288 yearling black bass, 100 yearling sunfish, and 150 yearling catfish, which were delivered to applicants in Maryland and Pennsylvania. The work was completed on May 4 and the car then proceeded to Washington.

On May 8, 350 yearling black bass and 55 adult black bass were delivered to the car at Washington from the Fort Humphreys (Va.) station. The car left Washington on the morning of May 9 and proceeded to Elizabeth, N. J., where these fish were delivered to the Union County Park Commission. After completing this trip the car returned to White Sulphur Springs, W. Va., to continue the distribution from that station.

Trips to Williamsport, Allentown, Oil City, and Stroudsburg, Pa., were completed between May 10 and June 7 delivering 208,500 fingerling brook trout, 33,400 rainbow trout, and 127,800 Loch Leven trout to applicants in New York, New Jersey, Maryland, Pennsylvania, Virginia, and West Virginia. During May, messengers operating from the car, delivered 48,000 black-bass fry, 40 adult black bass, and 70 yearling sunfish from Washington to points in North Carolina, Ohio, and Virginia. The distribution from the White Sulphur Springs station was completed on June 7 and the car was ordered to Bucksport, Me., arriving at that point on June 16.

On June 18, 95,900 fingerling brook trout and 23,200 fingerling landlocked salmon were obtained from the East Orland (Me.) station and the car proceeded to Vanceboro, Me. These fish were distributed to applicants at various points along the Maine Central Railroad between Bangor and Vanceboro. After completing this trip the car returned to Bucksport. On June 21, 106,050 fingerling brook trout were obtained from the East Orland (Me.) station for delivery to applicants in Pennsylvania and nursery ponds at Catoctin, Md. The car arrived at Frederick, Md., on the morning of June 23 and the fish were transported from Federick to the nursery ponds by truck. After completing this work the car returned to Washington, D. C.

From March 16 to June 30, car No. 10 made 12 trips and traveled 11,486 miles. Detached messengers made 60 trips and traveled 11,048 miles. The following tabulation will show the number, size, and species of fish delivered.

Species	Fry	Fingerlings			Yearlings	Adults
		No. 1	No. 2	No. 3		
Catfish					150	
Landlocked salmon		23,200				
Rainbow trout		53,400	155,400	33,400		
Loch Leven trout		130,000	151,600			
Brook trout		798,000	387,950	139,550		75
Largemouth black bass	48,000				638	95
Sunfish					170	
Yellow perch	180,000				800	
Total	228,000	1,004,600	694,950	172,950	1,758	170